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Article

Ways of Price Making and the Challenge of Market Governance in U.S. Energy Law

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> It does seem certain that a touch of the motley rests upon the ways of price making.
>
> -Walton Hamilton et al., Price and Price Policies 530 (1938).

INTRODUCTION

Prices are the lifeblood of markets. They provide vital information about supply and demand, signaling to consumers and producers alike and allowing individual preferences and decisions to come together in market transactions. As every student of economics learns, the price for a particular good or service in a competitive market is determined by the interaction of supply and demand.[1] Prices thus provide a powerful means for coordinating economic activity in a manner that maximizes allocative efficiency.[2] By allowing the decentralized, tacit knowledge of producers and consumers to coalesce and constitute new forms of economic order, the "wisdom of prices," to use an explicitly Hayekian frame, has long been promoted as superior to planning and regulation as a means of governing economic activity.[3]

To be sure, most economists long ago abandoned the simple notion of price formation that populates introductory economics textbooks. Price theory, to the extent that it represents a defined subfield within economics, has been refined and adjusted over the years to accommodate all manner of concerns with the functioning of imperfectly competitive markets, the influence of industry structure, the

1. *See, e.g.*, GEORGE J. STIGLER, THE THEORY OF PRICE 176 (3d ed. 1966) ("Everyone knows that prices are set by supply and demand.").

2. *See, e.g.*, MILTON FRIEDMAN, PRICE THEORY 10–11 (1962) ("The problem solved by a price system is an extremely complicated one, involving the coordination of the activities of tens and hundreds of millions of people all over the globe and their prompt adjustment to ever-changing conditions. The price system is an extremely subtle and complex device for solving this problem.").

3. Hayek was quite critical of the neoclassical model of perfect competition, emphasizing instead the role of competition and the price system as tools for discovery and knowledge aggregation. *See, e.g.*, F.A. Hayek, *Competition as a Discovery Procedure*, 5 Q.J. AUSTRIAN ECON. 9, 13 (2002) (Marcellus S. Snow trans., 1968) (remarking upon "the absurdity of the conventional approach proceeding from a state in which all essential conditions are assumed to be known"); F.A. Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV. 519, 526–27 (1945) ("We must look at the price system as such a mechanism for communicating information if we want to understand its real function. . . . The most significant fact about this system is the economy of knowledge with which it operates, or how little the individual participants need to know in order to be able to take the right action."); *see also* Richard Bronk, *Hayek on the Wisdom of Prices: A Reassessment*, 6 ERASMUS J. PHIL. & ECON. 82, 90 (2013) ("Thanks to the information conveyed by prices, individual agents can act with the benefit of a type of wisdom that is digestible and yet more comprehensive than they alone could otherwise acquire or even understand.").

role of money, credit, and interest, different short- and long-term effects, and the stickiness of certain prices (among others).[4] But prices in most competitive markets are often still assumed, at least over the long run, to reflect the fundamentals of supply and demand.[5] As such, they are also generally presumed to be fair—a presumption that has long informed and supported various forms of economic regulation.[6] When market distortions or manipulation cause prices to depart from their competitive levels, regulation is sometimes called upon to restore competition and thus allow prices to return to their "natural" state.[7]

This overly stylized story ignores for the most part the complex ways in which prices are actually made in many markets. It asserts rather than investigates the functioning of particular price mechanisms in particular markets. Like any powerful metaphor, the idea that prices emerge from the interaction of supply and demand

4. *See, e.g.*, JOHN MAYNARD KEYNES, THE GENERAL THEORY OF EMPLOYMENT INTEREST AND MONEY 292 (1936) ("So long as economists are concerned with what is called the Theory of Value, they have been accustomed to teach that prices are governed by the conditions of supply and demand . . . . But when they pass in volume II, or more often in a separate treatise, to the Theory of Money and Prices, we hear no more of these homely but intelligible concepts and move into a world where prices are governed by the quantity of money, by its income-velocity, by the velocity of circulation relatively to the volume of transactions, by hoarding, by forced saving, by inflation and deflation . . . ."); Frank H. Knight, *Cost of Production and Price over Long and Short Periods*, 29 J. POL. ECON. 304, 304 (1921) ("Great difficulties are met with in stating a clear and straightforward exposition of price theory because of the fact that the given conditions or data of the problem are so different according to the length of the time period which the explanation takes into account."). For a recent statement on price theory that canvasses some of the history discussed here, see E. Glen Weyl, *Price Theory*, 57 J. ECON. LITERATURE 329 (2019).

5. *See* Philip Mirowski, *Twelve Theses Concerning the History of Neoclassical Price Theory*, 38 HIST. POL. ECON. (ANN. SUPP.) 343, 371 (2006) ("For the bulk of its history, the neoclassical program equated 'science' with uncovering the generic abstract operation of phenomenologically diverse markets and distilling those insights into a small number of 'laws of supply and demand.'").

6. *See, e.g.*, William Boyd, *Just Price, Public Utility, and the Long History of Economic Regulation in America*, 35 YALE J. ON REGUL. 721 (2018) (discussing historical conceptions of just price and the idea that competitive markets operating under "normal" conditions generate just or fair prices).

7. The idea of a "natural" competitive price comes from Smith. *See* ADAM SMITH, AN INQUIRY INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS 83 (1796) ("The price of monopoly is upon every occasion the highest which can be got. The natural price, or the price of free competition, on the contrary, is the lowest which can be taken. . . . The one is upon every occasion the highest which can be squeezed out of the buyers, or which it is supposed they will consent to give: The other is the lowest which the sellers can commonly afford to take, and at the same time continue their business.").

(whether represented in the familiar graphs from economic textbooks or conceived as the workings of Adam Smith's invisible hand) has both illuminated and obscured the ways that markets work in the real world.

This Article takes a different approach. It starts with the practice of price making—what Walton Hamilton once referred to as the "ways of price making"—in particular markets.[8] It focuses on the instrumentalities of price formation; that is, on the mechanisms and practices that generate prices in specific markets. By investigating these concrete ways of price making, the Article seeks to advance our thinking about how law, technology, and economics come together to fashion markets and some of the concomitant challenges for regulation.

The Article draws on recent work across several disciplines that takes the building and maintenance of markets—and the tools, techniques, and knowledge practices that make this possible—as key objects of inquiry.[9] It also reaches back to earlier work by legal realists and institutional economists and, in particular, to the work of Walton Hamilton. More than any of his fellow travelers in economics and law, Hamilton, who operated in both worlds, focused on the actual practices of price making in specific industries, and was outspoken in his admonishments of economists and others for their hasty embrace of abstract theory at the expense of the concrete.[10]

8. *See* WALTON HAMILTON, MARK ADAMS, ALBERT ABRAHAMSON, HELEN EVERETT MEIKLEJOHN, IRENE TILL & GEORGE MARSHALL, PRICE AND PRICE POLICIES 530 (1938).

9. *See, e.g.*, DONALD MACKENZIE, AN ENGINE, NOT A CAMERA: HOW FINANCIAL MODELS SHAPE MARKETS 13 (2006) (emphasizing the importance of understanding the "infrastructures of markets: the social, cultural, and technical conditions that make them possible"); Fabian Muniesa, Yuval Millo & Michel Callon, *An Introduction to Market Devices, in* MARKET DEVICES 2 (Michel Callon et al. eds., 2007) (describing the roles played by a wide array of market devices in constructing markets such as analytical techniques, pricing models, aggregate indicators, and trading protocols); Trevor Pinch & Richard Swedberg, *Introduction to* LIVING IN A MATERIAL WORLD: ECONOMIC SOCIOLOGY MEETS SCIENCE AND TECHNOLOGY STUDIES (Trevor Pinch & Richard Swedberg eds., 2008) ("The market . . . is not just some abstract structure of social relations or an institution consisting of rules and regulations; it also involves material objects, be it in the form of balances, coins, tickers, telephones, or computers."); Fabian Muniesa, *Market Technologies and the Pragmatics of Prices*, 36 ECON. & SOC'Y 377 (2007) (discussing the techniques used to construct closing prices for the Paris Stock Exchange); Marion Fourcade, *Price and Prejudice: On Economics and the Enchantment (and Disenchantment) of Nature*, *in* THE WORTH OF GOODS 45 (Jens Beckert & Patrik Aspers eds., 2011) ("Many pricing technologies, then, are tools (complex, highly sophisticated economic tools) that bring markets into existence. That is, they are technologies whose purpose is to construct a space of 'tradability.'").

10. *See* HAMILTON ET AL., *supra* note 8, at 543 ("A vogue among persons who will neither get down to the concrete nor probe beneath the surface is to say that price is made by supply and demand, to dub a truism as a natural law, and to let it go at that.");

Rather than assuming the existence of a price mechanism as the core of any well-functioning market, therefore, this Article asks *how* these mechanisms are constructed and maintained. Answering that question requires close attention to the techniques and practices that generate prices and allow markets to function.[11] Such a perspective, it is argued, provides an important complement to more traditional understandings of markets in law and economics as well as more recent critical work traveling under the rubric of law and political economy. By investigating the micro-level details of how prices are actually formed, we can begin to see how seemingly technical questions of market design are fundamental to broader questions about power, distribution, and the political economy of markets.

In keeping with such a perspective, this Article argues that prices, and the ways of price making that stand behind them, are never simply facts or things that emerge out of markets, but instead, are ongoing objects of struggle.[12] To that end, one of the key objectives of this Article is to show how the struggle over prices has moved upstream to become a struggle over the ways of price making in particular markets—highlighting the need for a more robust political economy of market design. For it is in this "hidden abode" of price making that some of the most intense forms of rent seeking and conflict between market participants now occur.[13] Although this requires getting

see also MALCOLM RUTHERFORD, THE INSTITUTIONALIST MOVEMENT IN AMERICAN ECONOMICS, 1918-1947: SCIENCE AND SOCIAL CONTROL 81–84 (2011) (discussing Hamilton's study of price and price policies and his broader role in New Deal debates about price control); William J. Novak, *Institutional Economics and the Progressive Movement for the Social Control of American Business*, 93 BUS. HIST. REV. 665, 685–86 (2019) (characterizing Hamilton's institutionalist conception of prices as "a revolutionary approach . . . [that] paved the way for the mass of empirical and sociohistorical investigations of pricing in particular industrial and institutional settings that dotted early twentieth century economic writing").

11. *See, e.g.*, DONALD MACKENZIE, MATERIAL MARKETS: HOW ECONOMIC AGENTS ARE CONSTRUCTED 182 (2009) ("[T]reating 'the market' as a singular entity is mistaken . . . . Of the many markets that are possible, *which* markets we have matters, and that is a question not simply of their overall characteristics but of the details of their design, the technological infrastructures that support them, and the way economic agents in them are constructed . . . .").

12. Max Weber, among others, specifically emphasized this view of price as an object of struggle. *See* MAX WEBER, ECONOMY AND SOCIETY 201 (Keith Tribe ed. & trans., 2019) ("Money prices are the product of contest and compromise, and hence are outcomes of power constellations."); *see also id.* (describing the "price system" as a "struggle of man against man" and prices as "expressions of the struggle").

13. With apologies to Karl Marx who used this phrase to refer to the sphere of production, where profits are made. *See* 1 KARL MARX, CAPITAL: A CRITICAL ANALYSIS OF CAPITALIST PRODUCTION 154–55 (Frederick Engels ed., Samuel Moore & Edward Aveling trans., 1902) ("Accompanied by Mr. Moneybags and by the possessor of labor-power,

into the technical details of these markets at times, it is precisely on this more technical terrain where so much of the politics of economic regulation now takes place.[14]

The Article develops these arguments through an investigation of two particular markets in the United States: natural gas and electricity. Both of these markets emerged out of actions by Congress and the Federal Energy Regulatory Commission (FERC or the Commission) to restructure previously regulated industries by unbundling certain components and subjecting them to competition.[15] In the process, distinctive ways of price making have taken shape in these markets; namely, price indices in natural gas markets and market-clearing

we therefore take leave for a time of this noisy sphere, where everything takes place on the surface and in view of all men, and follow them both into the hidden abode of production, on whose threshold there stares us in the face 'No admittance except on business.' Here we shall see, not only how capital produces, but how capital is produced. We shall at last force the secret of profit making."); *see also* WALTER MATTLI, DARKNESS BY DESIGN: THE HIDDEN POWER IN GLOBAL CAPITAL MARKETS 4 (2019) ("Markets are more than simple coordination systems or 'disembodied' meeting places of demand and supply. They are organizations governed by their own rules and regulation. Moreover, markets are deeply political organizations or governance systems where contending groups of members or stakeholders are frequently embroiled in intense battles to shape market rules and structure according to their own narrow preferences.").

14. *Cf.* ANNELISE RILES, COLLATERAL KNOWLEDGE: LEGAL REASONING IN THE GLOBAL FINANCIAL MARKETS 223 (2011) (arguing that the "technicalities" of financial regulation are at the very core of financial governance and, as such, are "profoundly political practices"); MACKENZIE, *supra* note 11, at 33 ("That the design of markets—for example, the formal and informal rules that govern them—is a political matter is true more widely. Apparently minor matters—'technicalities,' often technicalities little understood by non-participants—can have big effects, . . . giving advantages to some actors and some strategies and disadvantaging others. . . . An effective politics of markets—whether 'left-wing or 'right-wing' in inspiration—needs to engage with such apparent 'technicalities,' not just with the overall virtues and demerits of markets."); Marc K. Landy & Martin A. Levin, *Creating Competitive Markets: The Politics of Market Design*, *in* CREATING COMPETITIVE MARKETS: THE POLITICS OF REGULATORY REFORM 9–12 (Marc K. Landy et al. eds., 2007) (noting the intense politics and rent seeking directed at various market design processes).

15. *See* Pipeline Service Obligations and Revisions to Regulations Governing Self-Implementing Transportation; And Regulation of Natural Gas Pipelines After Partial Wellhead Decontrol, 57 Fed. Reg. 13,267, 13,270 (Apr. 16, 1992) FED. ENERGY REGUL. COMM'N, Order No. 636 (Apr. 8, 1992) [hereinafter Order 636] (unbundling natural gas pipeline business and imposing open access regime for interstate transportation of natural gas); Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities, 61 Fed. Reg. 21,540, 21,541–43 FED. ENERGY REGUL. COMM'N, Order No. 888 (May 10, 1996) (to be codified at 18 C.F.R. pt. 35) [hereinafter Order 888] (summarizing final rules requiring unbundling and open access nondiscriminatory transmission services in order to promote competitive wholesale markets).

algorithms in wholesale electricity markets.[16] In both cases, the Article seeks to open the black box of price making to understand how they function and the challenges facing regulators charged with market oversight and regulation.

These cases are important in their own right. Price formation in both natural gas and electricity has become a major preoccupation at FERC since the early 2000s, when market manipulation and gaming conspired with bad market design to create severe disruptions in natural gas and electricity markets across California and the western United States, ultimately costing the California economy as much as forty-five billion dollars.[17] As this Article shows, FERC has struggled ever since the California crisis to engage in sufficient oversight and surveillance of market conditions, to fashion workable rules for these markets, and to enforce against manipulation and gaming. To be sure, FERC has been aggressive in using the new investigation and enforcement authority that Congress gave it in 2005.[18] But the importance of price formation in these markets goes well beyond the issue of manipulation, posing hard questions about markets, jurisdiction, and the structure of federalism that animates much of U.S. energy law. Indeed, each of the three major Supreme Court cases on energy since 2015 has focused on jurisdictional questions stemming from the ways of price making in natural gas and electricity markets.[19] And ongoing

16. *See infra* Parts II.C, III.C.

17. *See generally* FED. ENERGY REGUL. COMM'N, FINAL REPORT ON PRICE MANIPULATION IN WESTERN MARKETS: FACT-FINDING INVESTIGATION OF POTENTIAL MANIPULATION OF ELECTRIC AND NATURAL GAS PRICES, Docket No. PA02-2-000, at ES-1 to -2 (2003) [hereinafter FINAL REPORT] (concluding that dysfunction in natural gas and electricity markets fed off each other during the crisis and resulted in part from manipulation of natural gas price indices and California wholesale electricity prices); CHRISTOPHER WEARE, THE CALIFORNIA ELECTRICITY CRISIS: CAUSES AND POLICY OPTIONS 3–4 (2003) (estimating $40 billion in added energy costs and $40–45 billion in total costs, which at the time was around 3.5% of the state's total annual economic output).

18. The Energy Policy Act of 2005 (EPAct 2005) gave FERC new civil penalty authority of up to $1 million per day per violation. *See* 16 U.S.C. § 825o-1. Total Civil Penalties assessed for all years 2007 to present: $784,194,020. . . . Total Disgorgement ordered for all years 2007 to present: $518,070,718. For compiled figures, see *All Civil Penalty Actions–2020*, FED. ENERGY REGUL. COMM'N, https://www.ferc.gov/enforcement-legal/enforcement/civil-penalties/all-civil-penalty-actions-2020 [https://perma.cc/T86U-WT59]. *See also* FED. ENERGY REGUL. COMM'N, STAFF WHITE PAPER ON ANTI-MARKET MANIPULATION ENFORCEMENT EFFORTS TEN YEARS AFTER EPACT 2005 (2016) [hereinafter STAFF WHITE PAPER] (reviewing ten years of experience under the Commission's anti-manipulation rules).

19. Oneok, Inc. v. Learjet, Inc., 575 U.S. 373 (2015) (addressing jurisdictional issues emerging out of the manipulation of natural gas price indices); Fed. Energy Regul. Comm'n v. Elec. Power Supply Ass'n, 136 S. Ct. 760 (2016) (addressing compensation for demand response in the wholesale energy markets); Hughes v. Talen Energy Mktg.,

controversies regarding how to value various generation attributes and how to handle state subsidies for certain resources within the pricing structures in the organized electricity markets have only grown in intensity since those cases were decided.[20]

By focusing specifically on the ways of price making in natural gas and electricity—how they evolved in the context of restructuring, how they work (and sometimes fail to work), how they have been manipulated and gamed, and how they have come to be viewed as key objects in a broader competitive struggle—this Article develops a novel way of thinking about U.S. energy law and the challenges confronting FERC in its effort to ensure that the prices formed in these markets are just and reasonable. Such a perspective reveals that the fundamental challenge confronting FERC is more of a conceptual challenge than a legal one. As we will see, FERC's tentative and uneven efforts to engage in more oversight and regulation of price indices in natural gas and market-clearing algorithms in wholesale electricity markets result in part from (and, at the same time, serve to reinforce) a view of markets and competition that derives in large part from neoclassical price theory. Although the Commission clearly recognizes the importance of price formation in these markets and has opened multiple dockets, convened technical conferences, and launched investigations,[21] it has tended to treat price making in largely neutral terms, viewing it as a function of underlying market forces rather than as a constitutive technology that has become an object of struggle among market participants. This has translated into a focus on market structure and the conduct of market participants rather than on the infrastructure and instrumentalities of price formation, which have been left largely in the hands of third parties. As this Article argues, FERC needs to complement its ongoing focus on market structure and conduct with more

L.L.C., 136 S. Ct. 1288 (2016) (addressing state payments to certain generation resources and their implications for capacity markets). There has been a large amount of commentary on what these cases mean for the Federal Power Act's (FPA's) jurisdictional "bright line" between state and federal authority. *Compare* Matthew R. Christiansen & Joshua C. Macey, *Long Live the Federal Power Act's Bright Line*, 134 HARV. L. REV. (forthcoming 2021) (arguing that the FPA's jurisdictional bright line is alive and well and developing a framework that integrates the trio of recent Supreme Court cases in a defense of the bright line), *with* Jim Rossi, *The Brave New Path of Energy Federalism*, 95 TEX. L. REV. 399, 403 (2016) (arguing that these cases blur the line beyond recognition and usher in a new era of concurrent jurisdiction).

20. *See* Grid Resiliency Pricing Rule, 82 Fed. Reg. 46,940 (proposed Oct. 10, 2017); FED. ENERGY REGUL. COMM'N, 162 FERC ¶ 61,012, GRID RELIABILITY AND RESILIENCY PRICING (2018); *see also* discussion *infra* Part III.C.

21. *See* discussion *infra* Parts II.B–C, III.B–C.

direct oversight and regulation of these ways of price making, something it has ample legal authority to do.

In addition to the importance of these cases on their own terms, they also speak to more general concerns about markets, politics, and regulation—concerns that are especially relevant in a world where markets of all sorts are increasingly the product of active design.[22] To that end, the Article makes three larger claims. First, it argues that while prices play an important epistemic role in coordinating economic activity (Hayek's key insight),[23] such a view misses the fundamental ways in which prices (and the price system) are political. While this matters more in some markets, and with some prices, than in others, once we recognize that prices are not simply economic signals, we can begin to see a broader set of possibilities regarding the use of markets to achieve various ends and we can recognize (yet again) that there is no pre-political set of criteria for deciding how to harness the power of competition and direct it toward public ends. Second, the Article argues that the modalities of price making are where much of the politics of markets now occur. Understanding the micro-level details of how markets and the price mechanisms that power them are designed and maintained is crucial to understanding larger questions of power, distribution, and political economy. Third, the Article underscores that when it comes to systems of provisioning for certain economic necessities (long the traditional domain of public utilities), we must always remember that the instrumentalities of price making that determine the terms of access to these necessities are themselves critical pieces of shared infrastructure.[24] As such, there is a strong public interest in ensuring that they have integrity and are able to perform their functions. In a broad sense, they might even be considered as public utilities in their own right.[25]

22. *See, e.g.*, Matthew Kassel, *Beware Algorithms that Could Collude on Prices*, WALL ST. J., (Apr. 1, 2019) ("Companies are increasingly using algorithms to help them set prices for air travel, ride sharing, gasoline and a range of other goods."); *see also* MATTLI, *supra* note 13, at 49 (describing the dramatic transformation of capital markets over the past two decades as a product of "power politics" involving a "small number of insiders" who "began to quietly push for a different structure that offered a better alignment with their changing commercial interests").

23. *See* Hayek, *The Use of Knowledge in Society*, *supra* note 3, at 526–27.

24. *See, e.g.*, K. Sabeel Rahman, *Infrastructural Regulation and the New Utilities*, 35 YALE J. ON REGUL. 911, 913 (2018) (framing the question of infrastructural regulation as "how to regulate and govern foundational infrastructure—those goods and services that are essential, upon which much of our economic and social life are built").

25. *Id.* at 914; *see also* William Boyd, *Public Utility and the Low-Carbon Future*, 61 UCLA L. REV. 1614, 1619–20 (2014) (arguing for a broad normative conception of public utility that is not tied to any particular business model or type of entity).

The Article proceeds as follows. Part I provides background for the rest of the Article and elaborates on the analytical approach that frames the inquiry. Parts II and III, which comprise the empirical core of the Article, investigate the ways of price making in restructured natural gas and electricity markets respectively, focusing specifically on the price indices and market clearing algorithms at the center of these markets. The central claim here is that FERC's tendency to view these markets in overly abstract terms, its reliance on what it has often referred to as the "forces of competition" to discipline prices, and its decision to leave regulation of the actual mechanisms of price making to third parties[26] have created significant conceptual and regulatory challenges for the Commission, raising important questions about its ability to carry out its responsibilities as these markets grow in size and complexity. As these Parts show, however, FERC has ample legal authority to engage in more direct oversight of these mechanisms of price formation. Among other things, regulation of price indices and market clearing algorithms would seem to fit easily within FERC's authority under both the Natural Gas Act and the Federal Power Act to regulate "practices" that directly affect rates.[27] Each of these Parts thus concludes with a discussion of possible reforms. Finally, Part IV draws out some of the more general lessons from these case studies and engages with broader debates about how to understand and investigate ways of price making and the problem of markets in U.S. energy law and beyond.

I. FROM PRICES TO PRICE MAKING

Writing in 1958, Joan Robinson chided her fellow economists for their misguided quest to develop a general theory of prices. "Ever since Adam Smith," she wrote, "economists have been looking for a simple general theory of prices to fit all cases."[28] Such an undertaking, she continued, was "a will o' the wisp. Prices are a social phenomenon

26. *See* discussion *infra* Parts II.C, III.C.

27. Natural Gas Act § 5(a), 15 U.S.C. § 717d(a); Federal Power Act § 206(a), 16 U.S.C. § 824e(a). Two recent Supreme Court cases, *EPSA* and *Oneok*, both address the scope of practices affecting rates. *See, e.g.*, Fed. Energy Regul. Comm'n v. Elec. Power Supply Ass'n, 136 S. Ct. 760, 764 (2016) (approving lower court decision that limits FERC's "affecting" jurisdiction to rules or practices that directly affect the wholesale rate); Oneok, Inc. v. Learjet, Inc., 575 U.S. 373, 378–79 (2015) (discussing FERC's jurisdiction under the Natural Gas Act over practices affecting rates); *see also* Joel B. Eisen, *FERC's Expansive Authority to Transform the Electric Grid*, 49 U.C. DAVIS L. REV. 1783, 1817–34 (2016) (tracing history of "practices affecting rates" jurisprudence).

28. Joan Robinson, *Some Reflections on the Philosophy of Prices*, 26 MANCHESTER SCH. ECON. & SOC. STUD. 116, 135 (1958).

and the pricing system in any economy is geared to its social and political system."[29]

In addition to her own considerable accomplishments as an economist (among other things she played a key role in developing the theory of imperfect competition), Robinson, of course, was one of the great interlocutors of Keynes and, unlike most of her peers, had engaged deeply with Marx.[30] This breadth of learning, combined with a maverick sensibility, likely fed her more social and relational views of price and her limited patience for mainstream economic theory. For Robinson, "the market, by its very nature, is . . . a scene of conflicting interests" and prices were as much a "moral and political problem" as an economic problem.[31]

But Robinson was clearly swimming against the mainstream. Her ideas regarding the social aspects of markets and prices failed to get traction in the wider discipline of economics that was in the midst of a "formalist revolution" during the middle decades of the twentieth century.[32] Indeed, at almost precisely the time she was writing, formal mathematical modeling was emerging as the dominant tool in economics.[33] Most pertinent to this Article, a second generation of Chicago School economists, notably George Stigler and Milton Friedman, were refining their own version of neoclassical price theory and preparing the ground for their critique of economic regulation.[34]

29. *Id.*

30. Key works include: JOAN ROBINSON, THE ECONOMICS OF IMPERFECT COMPETITION (1933); JOAN ROBINSON, AN INTRODUCTION TO THE THEORY OF EMPLOYMENT (1939); JOAN ROBINSON, AN ESSAY ON MARXIAN ECONOMICS (1947).

31. 5 JOAN ROBINSON, *Markets*, *in* COLLECTED ECONOMIC PAPERS 164 (1979) ("The doctrines of laissez faire were very attractive, not only to those who gained most directly from the market system. If the economy is a self-regulating mechanism and economics a system of scientific laws, moral and political problems are excluded from it. Questions of social justice do not arise, all the operations of public administration are to be strictly neutral between interested parties. Ethics can be discussed on Sunday. It is considered unsound, soft-headed and unpatriotic to bring it in to week-day business. As soon as we recognize that the market, by its very nature, is necessarily a scene of conflicting interests, every element in it . . . becomes a moral and political problem. This is tormenting because there are no longer any 'principles of economics' to provide safe and simple rules for finding the correct solutions.").

32. *See, e.g.*, Mark Blaug, *The Formalist Revolution of the 1950s*, 25 J. HIST. ECON. THOUGHT 145, 145 (2003) (observing that the "metamorphosis of economics in the late 1940s and 1950s is aptly called a 'formalist revolution' because it was marked, not just by a preference, but by an absolute preference for the form of an economic argument over its content").

33. *Id.*

34. *See* J. Daniel Hammond, *The Development of Post-War Chicago Price Theory*, *in* THE ELGAR COMPANION TO THE CHICAGO SCHOOL OF ECONOMICS (Ross B. Emmett ed., 2010)

Needless to say, this growing formalization of economics had widespread implications for the field and marked an end to an earlier era of pluralism.[35] Prior understandings of markets as concrete places of exchange were thoroughly subsumed by abstract models of the market as a price-making mechanism,[36] with prices increasingly viewed as signals or bits of information that emerged out of markets.[37] Within the confines of the neoclassical model, very little attention was given to the question of price adjustment in competitive markets.[38]

(discussing post-war development of Chicago price theory through the work of Milton Friedman and George Stigler). Hammond describes "Chicago law and economics" as "Chicago price theory applied to problems of the law." *Id*. at 11; *see also* Steven G. Medema, *Chicago Price Theory and Chicago Law and Economics: A Tale of Two Transitions*, *in* BUILDING CHICAGO ECONOMICS: NEW PERSPECTIVES ON THE HISTORY OF AMERICA'S MOST POWERFUL ECONOMICS PROGRAM 151, 162–63 (Robert Van Horn, Philip Mirowski & Thomas A. Stapleford eds., 2011) (discussing heterogeneity in Chicago price theory).

35. *See, e.g.*, Mary S. Morgan & Malcolm Rutherford, *American Economics: The Character of the Transformation*, *in* FROM INTERWAR PLURALISM TO POSTWAR NEOCLASSICISM 1, 4–17 (Mary S. Morgan & Malcolm Rutherford eds., 1998) (describing transition from the pluralism of the interwar years to a "tool-kit" version of economics marked by formal, mathematical methods during the postwar period).

36. *See* Richard Swedberg, *Markets in Society*, *in* THE HANDBOOK OF ECONOMIC SOCIOLOGY 233, 240 (Neil J. Smelser & Richard Swedberg eds., 2d ed. 2005) (tracing this shift to the marginalist revolution during the late nineteenth and early twentieth centuries).

37. *See* SANFORD J. GROSSMAN, THE INFORMATIONAL ROLE OF PRICES 1 (1989) ("It is a common theme of most discussions of the competitive price system that prices convey information."). On the rise of an explicit economics of information, see PHILIP MIROWSKI & EDWARD NIK-KHAH, THE KNOWLEDGE WE HAVE LOST IN INFORMATION: THE HISTORY OF INFORMATION IN MODERN ECONOMICS (2017).

38. *See, e.g.*, Geoffrey M. Hodgson, *Markets*, *in* THE ELGAR COMPANION TO SOCIAL ECONOMICS 277, 278 (John B. Davis & Wilfred Dolfsma eds., 2015) ("For much of the twentieth century there has been little discussion of how specific markets are structured to select and authenticate information. Economists refer to the 'forces' of supply and demand, and locate market equilibria at the intersection of their curves in price-commodity space, but until recently they have offered little discussion of the mechanisms through which these forces operate."); 2 CHARLES R. PLOTT, MARKET INSTITUTIONS AND PRICE DISCOVERY: COLLECTED PAPERS ON THE EXPERIMENTAL FOUNDATIONS OF ECONOMICS AND POLITICAL SCIENCE, at xxiv (2001) (discussing "the mysterious process through which markets find price"); John Roberts, *Perfectly and Imperfectly Competitive Markets*, *in* THE NEW PALGRAVE: DICTIONARY OF ECONOMICS 10,196, 10,197 (Garett Jones et al. eds., 2018) (observing that perfect competition "is a theory of price competition that contains no coherent explanation of price formation"); Kenneth J. Arrow, *Toward a Theory of Price Adjustment*, *in* THE ALLOCATION OF ECONOMIC RESOURCES 41 (Moses Abramovitz ed., 1959) (discussing the "logical gap" regarding price adjustment in the neoclassical model).

Even less attention was directed at the question of how prices actually formed in existing markets.[39]

But if we look back to an earlier generation of institutional economists, legal scholars, and social theorists, we find alternative understandings of prices that emphasize, along with Robinson, their social and political dimensions while also pointing to the importance of understanding the different ways of price making operating in different markets. Max Weber, for example, viewed prices as objects of struggle that could only be understood in the context of "power constellations" and the ways in which various actors sought to influence what he called "the market situation."[40] Weber was very aware, in this respect, of the different ways that markets could be organized and the implications this had for prices. His early comparative studies of stock and commodity exchanges in Germany, France, England, and the United States, for example, demonstrated how the rules, institutions, and even the mechanisms used to communicate prices varied across different market formats and how they too became part of the general price struggle.[41]

39. *See* Marc R. Tool, *Contributions to an Institutional Theory of Price Determination*, *in* RETHINKING ECONOMICS: MARKETS, TECHNOLOGY AND ECONOMIC EVOLUTION 19, 20 (Geoffrey M. Hodgson & Ernesto Screpanti eds., 1991) ("The neoclassical 'price system' is alleged to be *concurrently* a pervasive characterization of how prices *tend to be* determined in most markets *and* a stipulation of how prices *ought to be* determined in virtually *all* markets. Departures from price-competitive market determinations are examined as pathology. The abstract ideal defines the *proper* price system. The normative use of this competitive model remains endemic in orthodox neoclassical theory generally. But within the sometimes contentious house of orthodoxy there is widespread recognition that the postulated theory of automatic, mechanistic price determination in free competitive markets is not necessarily *descriptively* adequate." (citation omitted)).

40. *See* WEBER, *supra* note 12, at 202 (referring to the "market situation" and the "competitive struggle").

41. *See* Max Weber, *Stock and Commodity Exchanges* (1894), *reprinted in* 29 THEORY & SOC'Y 305, 326 (Steven Lestition trans., 2000) (discussing importance of exchanges to national economy and observing "how tremendously important it is that the creating and determining of prices (of 'rates') take place in a secure and correct manner"). Weber goes on to discuss the different institutions and mechanisms used to govern these exchanges in Germany, England, and America. *Id.* And he clearly recognized the need to understand the specific rules and norms governing these different markets. *See id.* at 335 ("One must be clear about one thing: a general, overall supervision of the exchanges remains an empty word. It is [really] a question of which specific procedures one can and will control—or, regulate through legislative intervention—and, for example, which sorts of business, or which business between which people, one wants to prevent and can actually prevent."). Both Walras and Marshall, writing at roughly the same time as Weber, took stock exchanges—the Paris Bourse and the London Exchange in their respective cases—as the closest living examples of perfectly competitive markets and, accordingly, as models for their respective theories of price

Legal realists and institutional economists such as Robert Lee Hale and John Commons likewise viewed prices and price relationships in the context of a broader economy of mutual coercion structured by a shifting set of background entitlements.[42] As Hale put it, "prices and price relationships are decisive factors in modern economic life."[43] They "account directly for the economic inequalities which we observe between different classes in modern society."[44] At a more granular level, Gardiner Means, Walton Hamilton, and others rejected the simple neoclassical model of markets and prices and pointed instead to the ways in which large firms, often in concentrated industries, developed their own specific approach to setting prices (what Means referred to as "administered prices").[45]

formation. *See* J.A. Kregel, *Neoclassical Price Theory, Institutions, and the Evolution of Securities Market Organization*, 105 ECON. J. 459, 459 (1995). Coase, among others, criticized this view, taking a position that was much closer to Weber's. *See* Ronald H. Coase, Nobel Prize Lecture: The Institutional Structure of Production (Dec. 9, 1991), https://www.nobelprize.org/prizes/economic-sciences/1991/coase/lecture [https://perma.cc/XQC9-KHH3] ("Stock and produce exchanges are often used by economists as examples of perfect or near-perfect competition. But these exchanges regulate in great detail the activities of traders (and this quite apart from any public regulation there may be). What can be traded, when it can be traded, the terms of settlement and so on are all laid down by the authorities of the exchange. There is, in effect, a private law. Without such rules and regulations, the speedy conclusion of trades would not be possible."). More recently, Bernard Harcourt has used the Chicago Board of Trade to make a similar point, albeit with more attention to the distributional effects of these market rules and regulations. *See* BERNARD E. HARCOURT, THE ILLUSION OF FREE MARKETS: PUNISHMENT AND THE MYTH OF NATURAL ORDER 180 (2011) ("The Chicago Board of Trade is viewed as a free market; but it is, in truth, a disciplinary mechanism that keeps a market relatively ordered."); *id.* at 185 ("The rhetoric may be about the 'free market,' but the reality is layers upon layers of complex regulations and intricate rules . . . all of which distribute wealth.").

42. *See, e.g.*, ROBERT L. HALE, FREEDOM THROUGH LAW: PUBLIC CONTROL OF PRIVATE GOVERNING POWER 131 (1952) (arguing that market prices "result from and register the mutual pressures exerted by buyers and sellers. The amount of pressure which each can exert is very unevenly distributed, with the result that some are economically strong, others economically weak."); 1 JOHN R. COMMONS, INSTITUTIONAL ECONOMICS: ITS PLACE IN POLITICAL ECONOMY 260 (1934) (defining real value as the price that obtains in the absence of coercion).

43. Robert L. Hale, *The Constitution and the Price System: Some Reflections on* Nebbia v. New York, 34 COLUM. L. REV. 401, 401 (1934). On Hale and his understanding of markets as "a network of mutual coercion," see BARBARA H. FRIED, THE PROGRESSIVE ASSAULT ON LAISSEZ FAIRE: ROBERT HALE AND THE FIRST LAW AND ECONOMICS MOVEMENT 49–59 (1998).

44. Hale, *supra* note 43, at 402.

45. *See* GARDINER C. MEANS, INDUSTRIAL PRICES AND THEIR RELATIVE INFLEXIBILITY, S. DOC. NO. 74-13, at 1 (1935) ("An administered price is . . . a price which is set by administrative action and held constant for a period of time. . . . Many wholesale and most retail prices are administered rather than market prices."); GARDINER C. MEANS, PRICING

What united these various approaches was the recognition that politics and institutions determine the ways in which markets take shape and prices emerge. As articulated by Hamilton, the goal of this self-described field of "institutional economics" was to develop an understanding of "the economic order" that would explain "why some of us are better off than others."[46] "Such an explanation," he continued,

> cannot properly be answered in formulas explaining the processes through which prices emerge in a market. Its quest must go beyond sale and purchase to the peculiarities of the economic system which allow these things to take place upon particular terms and not upon others. It cannot stop short of a study of the conventions, customs, habits of thinking, and modes of doing which make up the scheme of arrangements which we call "the economic order."[47]

In his price studies, Hamilton was most interested in investigating "what lies back of a price—to make it high or low—to restrict or enlarge supply—to bring it within the reach of the few or the many."[48] "A price," he noted,

> is a monetary summary of all the conditions which give value to a ware; a system of prices is a pecuniary shorthand for an economy at work. As a result the phenomena of prices are as broad and varied as the industries whose structures, arrangements, and activities they reflect. The mark of accident, of custom, of conscious policy is upon every price.[49]

To be clear, Hamilton was hardly an enemy of markets. He recognized the important role of competition in disciplining prices—keeping them close to costs and ensuring that buyers and sellers alike would be protected from the exaction of unfair gains.[50] But he also

POWER AND THE PUBLIC INTEREST: A STUDY BASED ON STEEL 11–14 (1962) (discussing theory of administered prices); HAMILTON ET AL., *supra* note 8, at 25 ("[T]he phenomena of prices are as broad and varied as the industries whose structures, arrangements, and activities they reflect."); *see also* Robinson, *supra* note 31, at 156 ("Once it is recognized that competition is never pure or perfect in reality, it becomes obvious that there is great scope for individual variations in the price policy of firms.").

46. Walton H. Hamilton, *The Institutional Approach to Economic Theory*, 9 AM. ECON. REV. 309, 311 (1919).

47. *Id.*

48. *See* Malcolm Rutherford, *Walton H. Hamilton and the Public Control of Business*, 37 HIST. POL. ECON. 234, 255 (2005) (quoting Walton H. Hamilton, *Why the Price Studies?*, 1 CONSUMER 7 (1936)).

49. HAMILTON ET AL., *supra* note 8, at 25; *see also* Walton H. Hamilton, *Cost as a Standard for Price*, 4 LAW & CONTEMP. PROBS. 321, 332 (1937) (illustrating how modern cost accounting as a basis for price varies across firms and sectors).

50. *See* Walton H. Hamilton, *Affectation With Public Interest*, 39 YALE L.J. 1089, 1107 (1930) ("Where free enterprise prevails, price-control is indirect; the state enforces competition and trusts to an open industry and a free market to establish rightful prices. . . . Because of rivalry in their ranks sellers cannot charge too much; and because of a like rivalry among buyers, they are allowed to charge enough. The result is that prices will have a basis in costs, unfair charges cannot continue to prevail, and in

recognized, along with Hale, Commons, Means, and others, that competitive markets did not always function as intended and that some industries required more active regulation.[51] The traditional public utilities were the most obvious example given their "natural monopoly" characteristics.[52] In other sectors, when changing economic conditions allowed for the possibility of coercion, government intervention might be needed to ensure that "rightful prices" resulted from market exchange.[53]

In sum, Hamilton believed that the abstract model of the market economy embraced by neoclassical economic theory had limited relevance for understanding real-world conditions in the American economy during the middle decades of the twentieth century.[54] His detailed investigations of the ways of price making in various industries were intended to reveal the manner in which pricing practices departed significantly from the standard economic model.[55]

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the long run only reasonable gains can be taken. It is not assumed that under free enterprise price is beyond public concern; rather it is presumed that the market gives adequate protection.").

51. *See id.* ("Where an industry is closed, price-control is direct; the state undertakes to say what prices are fair to the parties concerned.").

52. *See id.* at 1108 ("Certain 'natural monopolies' and businesses which operate by exclusive franchise must be recognized as a class apart; the province of monopolistic industry is to be narrowly limited. Here buyers or sellers are not protected by competition between those with whom they must deal, and the state must accord the protection which in the usual case the market is supposed to afford. Accordingly, the state may resort directly to price-fixing."); *see also* HAMILTON ET AL., *supra* note 8, at 19 ("But the supply of water, of gas, and of electricity has been recognized as monopolistic in character. One by one such industries have been detached from the domain of competition, garnered into the category of public utilities, and entrusted to the regulatory oversight of public bodies.").

53. Hamilton, *supra* note 50, at 1107.

54. *Cf.* Robert L. Heilbroner, *The Problem of Value in the Constitution of Economic Thought*, 50 SOC. RSCH. 253, 274 (1983) (arguing that the "utility approach to price . . . recommends itself because it avoids troublesome considerations of class conflict and cooperation as the fundamental problem of social order, and puts in their place a view of social order as the outcome of individuals contending for pleasure or avoiding pain in an environment of scarcity. Whatever violence this may do to history—and I believe it is a fictive account at the level of Locke's social contract—it is much in tune with the conservative ideology of our time, and indeed helps to create and support that ideology.").

55. As the director of research for President Roosevelt's Cabinet Committee on Price Policy, Hamilton supervised a multi-year investigation into the pricing practices of numerous industries. The results of this work were reported in his PRICE AND PRICE POLICIES from 1938, which compiled detailed studies of pricing in the automobile, tire, cottonseed, dress, whiskey, and milk industries. *See* HAMILTON ET AL., *supra* note 8, at vii.

Ironically, elements of this perspective seem to have infiltrated (albeit in a very partial way) mainstream economics since the 1980s, as evidenced by the growing enthusiasm for mechanism design and experimental economics.[56] One of the key lessons of this work, according to several pioneers in the field, is that institutions and rules matter far more than the economic rationality or knowledge of individual agents in determining market outcomes.[57] Designing markets thus entails a form of institutional engineering that seeks to channel behavior in ways that comport with ideas of economically rational behavior rather than allowing that rationality to emerge and flourish unimpeded by specific rules and structures.[58] By taking markets and the rules and institutions that make them work as objects of conscious design and construction, mechanism design opened up a whole new world of direct intervention in the economy.[59]

56. *See, e.g.*, Roger B. Myerson, *Perspectives on Mechanism Design in Economic Theory*, 98 AM. ECON. REV. 586, 602 (2008) ("Mechanism design and other areas of game theory have contributed to a fundamental change in the scope of economics."); Alvin E. Roth, *The Economist as Engineer: Game Theory, Experimentation, and Computation as Tools for Design Economics*, 70 ECONOMETRICA 1341, 1341 (2002) ("[I]n the 1990s, economists, particularly game theorists, started to take a very substantial role in design, especially in the design of markets.").

57. *See, e.g.*, Vernon L. Smith, *Economics in the Laboratory*, 8 J. ECON. PERSP. 113, 116–18 (1994) (observing that one of the most important lessons from experimental economics and mechanism design is that institutions matter); Charles R. Plott, *Experimental Methods in Political Economy: A Tool for Regulatory Research*, *in* ATTACKING REGULATORY PROBLEMS 117, 134 (Allen R. Ferguson ed., 1981) ("The task is to find a system of institutions—the rules for individual expression, information transmittal, and social choice—a 'process' that mirrors the behavioral features of the mechanism. . . . This is a pure form of institutional engineering.").

58. *See* Francesco Guala, *How to Do Things with Experimental Economics*, *in* DO ECONOMISTS MAKE MARKETS? ON THE PERFORMATIVITY OF ECONOMICS 128, 145 (Donald MacKenzie et al. eds., 2007) ("The main idea behind mechanism design theory . . . is to treat institutions as variables that affect the allocation of economic goods. Normative (welfare) economics plays a role at the level of defining a set of criteria used to assess market allocations . . . . Then game theory enters the scene: the market institution is represented as a game that rational agents are trying to solve. The 'best' institution is the one that leads the agents to satisfy the welfare criteria 'as if guided by an invisible hand,' by setting the right incentives and by giving them enough information to solve the problem they are facing." (citation omitted)); *id*. at 147 ("Economic rationality is not like Newton's laws, which are supposed to be at work everywhere in the universe. It is a fragile property that must be carefully preserved by creating a hospitable environment. It is a *capacity* or a *potentiality*, and the goal of experimental market design is to create the 'right' circumstances for it to be actualized.").

59. *See* MIROWSKI & NIK-KHAH, *supra* note 37, at 148 ("[S]ince roughly 1980, the [economics] profession converged upon a more 'constructivist' approach to markets in the sense that it has become possible, for the first time, to acknowledge that market formats do indeed differ in significant ways; furthermore, it might be possible for economists to intervene in the setup and maintenance of these diverse structures. Where

The critical role of rules, devices, and techniques in constituting markets as well as the applied work of economists in building markets have not gone unnoticed by a new generation of social scientists focused on the institutional and technical infrastructures of price making in particular markets.[60] Rather than viewing prices as facts that emerge out of the interaction of supply and demand, these scholars seek to investigate the specific rules, techniques, and practices that make prices and in turn shape and format the ways in which supply and demand are allowed to interact.[61] By shaping the "space of tradability," they argue, different market designs, employing different pricing technologies, allow for different interactions between buyers and sellers.[62] Competition, in this view, is not some underlying force waiting to be unleashed, much less an end-state reflected in market structure, but a process that can be shaped and channeled in specific ways by different market formats and different ways of price making. Put another way, prices are not simply things that emerge from markets; rather, it is the specific ways of price making that allow different markets to emerge.

economists once placidly contemplated markets from without, situated in a space detached from their subject matter, so to speak, now they are much less disciplined about their doctrines concerning the nature of economic agency, and much more inclined to be found down in the trenches with other participants, engaged in making markets."); Guala, *supra* note 58, at 130 ("[E]xperimental economics can be (and has been) used effectively to *intervene*, to change the institutions that regulate and coordinate economic behavior. . . . With experimental economics, . . . you can *do things to the economy*. You can manipulate and intervene in the microeconomies you have built in your laboratory, and this activity in turn is instrumental to intervening in real-world, full-size markets.").

60. *See, e.g.*, MACKENZIE, *supra* note 9, at 13 (emphasizing the different infrastructures that support markets); Fabian Muniesa, Yuval Millo & Michael Callon, *An Introduction to Market Devices*, *in* MARKET DEVICES 1, 2 (Michel Callon et al. eds., 2007) (describing market devices as "the material and discursive assemblages that intervene in the construction of markets").

61. *See, e.g.*, Jens Beckert, *The Social Order of Markets*, 38 THEORY & SOC'Y 245, 264 (2009) ("Although changes in prices emerge from changes in supply and demand, these changes themselves are the result of the social, institutional and cognitive structures of markets."); Koray Caliskan, T*he Meaning of Price in World Markets*, 2 J. CULTURAL ECON. 239, 240 (2009) ("Price realization does not occur as a natural process, but depends on a set of technical devices and artificial equipment, which is almost never described in economic theory."); Fourcade, *supra* note 9, at 44 (discussing shift in economic sociology from "the *meaning* (social, symbolic, cultural) of prices to the *technologies* which sustain the price system").

62. Fourcade, *supra* note 9, at 45; *see also* Michel Callon & Fabian Muniesa, *Economic Markets as Calculative Collective Devices*, 26 ORG. STUD. 1229, 1240 (2005) (noting "the existence of a multiplicity of practical forms of confrontation between supply and demand" across different markets).

Seen from this perspective, the problem of price formation cannot be reduced to a problem of ensuring that the structure of any particular market is sufficiently competitive or that the conduct of market participants stays within the bounds of acceptable behavior. It is also a problem that requires close attention to the infrastructure and instrumentalities of price making and the various rules and institutions that determine how they work. In all such cases, moreover, it is a problem that cannot be divorced from politics. The technical aspects of price making, in fact, are where much of the politics of markets now reside.

Taken together, these insights add up to a powerful analytical framework for investigating the ways of price making in actually existing markets. Although the general approach can be applied to markets across the economy, this Article focuses specifically on price making in restructured natural gas and electricity markets. Aside from their foundational importance to the broader economy, there are two main reasons for focusing on natural gas and electricity. First, these markets were both products of government directed restructuring efforts that sought to replace one form of price making, cost-of-service regulation, with another, competition. Second, in both cases, the statutory frameworks governing these markets are very similar, and in both cases, FERC has an ongoing responsibility to ensure that prices are just and reasonable, which brings to the fore the question of when market prices can be viewed as fair prices.

As we will see, FERC's efforts to restructure these markets were based on the core conviction that the new markets could be kept relatively pure, thereby allowing competition to ensure that prices would meet the statutory just and reasonable standard.[63] As long as competition was robust, FERC could get by with a more minimalist, "light-handed" approach to regulation.[64] Competitive markets, in this view, would solve many of the problems that had plagued the cost-of-

63. *See, e.g.*, Oneok, Inc. v. Learjet, Inc., 575 U.S. 373, 380 (2015) (describing FERC's efforts to restructure the natural gas industry "as an approach that relied on the competitive marketplace, rather than classical regulatory rate-setting, as the main mechanism for keeping wholesale natural-gas rates at a reasonable level"); Coal. for Competitive Elec. v. Zibelman, 906 F.3d 41, 46 (2d Cir. 2018) ("FERC has determined that just and reasonable rates for wholesale electricity should be set by competitive auctions.").

64. *See* United Distrib. Cos. v. Fed. Energy Regul. Comm'n, 88 F.3d 1105, 1122 (D.C. Cir. 1996) (observing that with its natural gas restructuring effort FERC "has gradually withdrawn from direct regulation of certain industry sectors in favor of a policy of 'light-handed regulation' when market forces make that possible").

service ratemaking of the past.[65] Simply put, the discipline of competition could do a better job at setting "just and reasonable" prices than the discipline of regulation.[66]

From the outset, however, FERC failed to grasp the significance of the specific ways of price making operating at the heart of these markets—a conceptual blindspot that became painfully apparent during and after the California energy crisis of 2000–01, which greatly disrupted both natural gas and electricity markets throughout the western United States.[67] Among other things, the crisis illustrated how fragile these new markets were, how dependent they were on key technologies of price making, and how relatively easy they were to manipulate.

Although FERC recognized after the crisis that it had been naïve in its assumption that market forces should be allowed to run their course, it has struggled to develop a consistent and coherent approach to the techniques of price making that power these markets.[68] In

65. *See* Fed. Energy Regul. Comm'n v. Elec. Power Supply Ass'n, 136 S. Ct. 760, 768 (2016) ("In this new world [of competitive wholesale power markets], FERC often forgoes the cost-based rate-setting traditionally used to prevent monopolistic pricing. The Commission instead undertakes to ensure 'just and reasonable' wholesale rates by enhancing competition—attempting, as we recently explained, 'to break down regulatory and economic barriers that hinder a free market in wholesale electricity.'" (quoting Morgan Stanley Cap. Grp. v. Pub. Util. Dist. No. 1 of Snohomish Cnty., 554 U.S. 527, 536 (2008)).

66. *See, e.g.*, Regional Transmission Organizations, 65 Fed. Reg. 810, 811 (Jan. 6, 2000) FED. ENERGY REGUL. COMM'N, Order No. 2000 (Dec. 6, 1999) [hereinafter Regional Transmission Organizations] ("Competition in wholesale electricity markets is the best way to protect the public interest and ensure that electricity consumers pay the lowest price possible for reliable service.").

67. There is voluminous literature on the California electricity crisis. *See, e.g.*, WEARE, *supra* note 17, at 1–2 (2003) (describing the severe malfunctioning of the California electricity market); Paul L. Joskow, *California's Electricity Crisis*, 17 OXFORD REV. ECON. POL'Y 365, 377–78 (2001) (discussing increases in wholesale electricity prices in California); David B. Spence, *The Politics of Electricity Restructuring: Theory Vs. Practice*, 40 WAKE FOREST L. REV. 417, 417 (2005) (discussing California's "disastrous experience with restructured electricity markets").

68. *See, e.g.*, STAFF WHITE PAPER, *supra* note 18, at 2 ("During the Western Energy Crisis, the Commission's enforcement tools lagged behind these market developments, and the [manipulation] schemes exposed a major weakness in the Commission's ability to fulfill its core mission of ensuring just and reasonable rates and protect energy market participants and consumers. . . . [N]either the statutes administered by the Commission nor its rules, regulations, or orders contained any explicit prohibition or definition of market manipulation."). Not surprisingly, FERC was widely criticized for its handling of the California energy crisis. *See, e.g.*, GARY TAYLOR, SHAUN LEDGERWOOD, ROMKAEW BROEHM & PETER FOX-PENNER, MARKET POWER AND MARKET MANIPULATION IN ENERGY MARKETS: FROM THE CALIFORNIA CRISIS TO THE PRESENT 251 (2015) ("FERC was poorly prepared for the California Crisis. Its approach to constraining market power

essence, FERC has tended to view prices and the technologies that produce them as facts about the market rather than as explicit objects of struggle among market participants. As we will see, this has led to a persistent set of conceptual and regulatory challenges confronting the Commission as it has sought to establish a workable framework for market governance.

II. PRICE MAKING IN NATURAL GAS MARKETS

FERC launched its first major restructuring effort in the mid-1980s, focusing on the natural gas industry. Taking its cues from Congress, the Commission sought to unbundle the natural gas pipeline business, separating gas sales from gas transportation and establishing an open-access transportation regime that would provide the foundation for competitive natural gas markets.[69] In contrast to the cost-of-service model of the past, competition and market forces would ensure that prices for jurisdictional sales of natural gas comported with the statutory just and reasonable standard.[70] FERC would withdraw from direct regulation in favor of a posture of "light-handed regulation" when it judged that market forces were sufficiently robust to allow competition—rather than regulation—to set prices.[71]

It would take the better part of a decade to complete the effort and, by virtually all accounts, restructuring has been successful in creating robust markets and lowering prices.[72] Today, natural gas is traded throughout the country at dozens of active trading hubs, and since the early 1990s a deep and liquid market for futures contracts

was woefully antiquated, and it had failed to collect the data necessary to understand what was going on in the markets. The concept of fraud-based manipulation had not even entered the Commission's thinking. It had no workable model of manipulative behavior, no analytic approach for diagnosing it, and no remedial tools to deter it or compensate consumers for any consequential damage."); U.S. GEN. ACCT. OFF., ENERGY MARKETS: CONCERTED ACTIONS NEEDED BY FERC TO CONFRONT CHALLENGES THAT IMPEDE EFFECTIVE OVERSIGHT 84–86 (2002) (noting that FERC Commissioners recognized the Commission's shortcomings in responding to the crisis).

69. *See* Order 636, *supra* note 15 (unbundling natural gas pipeline business and imposing open access regime for interstate transportation of natural gas). The key features of Order 636 were upheld by the D.C. Circuit in 1996. *See* United Distrib. Cos. v. Fed. Energy Regul. Comm'n, 88 F.3d 1105, 1191 (D.C. Cir. 1996) ("In its broad contours and in most of its specifics, we uphold Order No. 636.").

70. *See* Order 636, *supra* note 15, at 13,297 (determining that prices for jurisdictional sales of natural gas "will be limited by a just and reasonable ceiling which is set by a competitive national gas market").

71. *See id.*

72. *See, e.g.*, Richard J. Pierce, Jr., *The Evolution of Natural Gas Regulatory Policy*, 10 NAT. RES. & ENV'T 53 (1995).

and other financial derivatives has emerged.[73] Price discovery in a market of such complexity and scope is quite challenging. There is no single prevailing price of natural gas in the United States, and no one really knows the total value of the U.S. natural gas market—a problem that FERC and others have pointed to repeatedly in their efforts to enhance market transparency.[74]

Because of the complexity of the market and the challenges of price discovery, much of the natural gas sold in the United States is tied in one way or another to one of a handful of price indices.[75] These price indices are published by private price reporting agencies such as Platts, a division of publishing giant McGraw-Hill, and Natural Gas Intelligence, a private family-owned company.[76] In the United States today, there are ten or so index publishers, which publish dozens of indices for the different trading hubs and market centers across the country.[77]

These indices emerged during the 1980s, as new wholesale markets for natural gas took shape in the wake of efforts by Congress and

73. Although natural gas is extracted throughout North America from both onshore and off-shore fields, the Henry Hub in Erath, Louisiana, serves as the primary cash market trading and distribution center for U.S. natural gas. The Henry Hub serves as a juncture for thirteen different pipelines that bring in natural gas from Gulf Coast fields and ship it to U.S. East Coast and Midwest consumption centers. The Henry Hub is also the delivery point and pricing basis for the New York Mercantile Exchange's natural gas futures contract, which is the most important pricing reference for U.S. natural gas. *See* Barbara Nelson Gray, *The Use of Risk-Management Products in the Natural Gas Industry: Overview*, 10 NAT. GAS CONT. NEWSL. 1 (1994) (noting that the New York Mercantile Exchange (NYMEX) began trading in natural gas futures contracts in April 1990).

74. *See, e.g.*, Transparency Provisions of Section 23 of the Natural Gas Act, 73 Fed. Reg. 1014, 1014 (Jan. 4, 2008) FED. ENERGY REGUL. COMM'N, Order No. 704 [hereinafter Order 704] ("Currently, because of the way transactions take place in the natural gas industry, there is no way to estimate even in the broadest terms the overall size of the natural gas market or its breakdown by types of contract provision, including pricing and term (e.g., spot or for delivery farther in the future).").

75. These indices reflect particular time periods (such as daily or monthly) and are tied to particular locations or hubs. The United States pioneered the "hub-based" approach to natural gas pricing, in which prices change from one location to another. The alternative approach to pricing, used in Europe and parts of Asia, is "oil indexing," in which the price of natural gas is indexed to the price of oil. *See* Dayong Zhang, Tiantian Wang, Xunpeng Shi & Jia Liu, *Is Hub-Based Pricing a Better Choice Than Oil Indexation for Natural Gas? Evidence from a Multiple Bubble Test*, 76 ENERGY ECON. 495, 496–97 (2018) (discussing different approaches to natural gas pricing).

76. Platts has been publishing industry and price information for oil and natural gas since the early twentieth century. *See* OWAIN JOHNSON, THE PRICE REPORTERS: A GUIDE TO PRAS AND COMMODITY BENCHMARKS 43–44 (2018).

77. *See id.*

FERC to restructure the industry.[78] During this time, FERC paid almost no attention to these price indices, assuming that they were natural features of an emerging market. Price indices, in other words, were viewed as reflections of the market (facts about the market) rather than as constitutive technologies that played a fundamental role in making these markets. With the California crisis of 2000–01, which involved, among other things, extensive manipulation of natural gas price indices, FERC began to recognize the critical role of these ways of price making.

But FERC has struggled since the California crisis to come up with a coherent approach to price indices and has persisted in leaving their oversight and regulation largely in the hands of third parties.[79] As this Part demonstrates, this reflects a conceptual blind spot in how FERC (and Congress) have tended to see these markets and their corresponding views of what constitutes a proper approach to market governance.

A. INDICES AND BENCHMARKS

A price index, as the name suggests, is a composite number meant to reflect the average value of a set of individual prices.[80] Simple price indices have been used for centuries, but the modern theory of index numbers and the widespread use of price indices in commerce, economics, and statistics are products of the twentieth century.[81] For the most part, these efforts focused on the construction of broad indices, such as the Consumer Price Index or the Dow Jones Industrial Average, meant to track changes in prices of a basket of different

78. *See* Craig R. Carver, *Natural Gas Price Indices: Do They Provide a Sound Basis for Sales and Royalty Payments*?, 42 ROCKY MTN. MIN. L. INST. 10, § 10.02 (1996) (tracing early history of natural gas price indices); John A. Harpole, *Natural Gas Price Indexes: Fact, Fiction, or Failure?*, 49 ROCKY MTN. MIN. L. INST. 14, § 14.05 (2003) (same).

79. *See infra* Parts II.B–C.

80. Here is how Irving Fisher described an index number: "If we look at prices as starting at any time from the same point, they seem to scatter or disperse like the fragments of a busting shell. But, just as there is a definite center of gravity of the shell fragments, as they move, so is there a definite average movement of the scattering prices. This average is the 'index number'." *See* IRVING FISHER, THE MAKING OF INDEX NUMBERS 2–3 (1922).

81. *See, e.g.*, *id.* at 458–60 ("Index numbers are a very recent contrivance . . . their current use did not begin till 1869 at the earliest, and not in a general way till after 1900."); *see also* WESLEY C. MITCHELL, THE MAKING AND USING OF INDEX NUMBERS 7–10 (1938) (discussing history of index numbers).

commodities or equities for the purpose of evaluating economic conditions and trends.[82]

Price indices are also used extensively in particular industries, such as natural resources, agricultural commodities, energy, and finance, as instruments for price discovery and as benchmarks for transactions.[83] The history of these kinds of indices is less well known, in part because these indices have typically grown out of efforts by market participants, the trade press, and industry analysts to solve practical problems of pricing posed by certain types of markets.[84] These price indices, moreover, have often been taken for granted, viewed as a natural part of the market landscape.[85] For a long time, they were all but invisible.

But in the wake of various high-profile manipulation cases, price indices and benchmarks have become more visible. The most famous recent example of such manipulation involved LIBOR—the London Interbank Offered Rate—that provides a benchmark rate for short-term loans between many of the world's largest banks.[86] LIBOR, which is actually a set of numbers tied to particular currencies for particular periods of time, affects more than $350 *trillion* of securities and loans globally.[87] It has been called the most important number in the

82. *See generally* H. Spencer Banzaf, *The Form and Function of Price Indexes: A Historical Accounting*, 36 HIST. POL. ECON. 589 (2004) (discussing history of price indices).

83. *See* Gabriel Rauterberg & Andrew Verstein, *Index Theory: The Law, Promise and Failure of Financial Indices*, 30 YALE J. ON REGUL. 1, 6 (2013) (explaining basic uses of index prices in various sectors and noting that "there are now over $1.6 trillion in assets invested in vehicles that track indices, and hundreds of trillions of dollars contractually based on an index referent" (footnote omitted)); JOHNSON, *supra* note 76, at 1 (discussing extensive use of price indices in commodities and energy markets).

84. *See* Rauterberg & Verstein, *supra* note 83, at 5 ("Academics and regulators have largely ignored the indispensable role indices play in markets, failing to articulate why financial indices have grown so quickly in importance, how they function, and the risks they face.").

85. *See id.* ("Indices are the indispensable and invisible infrastructure of modem finance . . . .").

86. *See, e.g.*, *id.* at 16–17 (describing how LIBOR is constructed); MACKENZIE, *supra* note 11, at 80–83 (discussing how LIBOR is constructed).

87. *See* Stephen M. Bainbridge, *Reforming LIBOR: Wheatley Versus the Alternatives*, 9 N.Y.U. J.L. & BUS. 789, 792 (2013) ("An estimated $350 trillion in financial products are based on the LIBOR rate.").

world.[88] And it was the target of an extensive manipulation scheme during and after the financial crisis of 2008.[89]

Needless to say, price indices perform vital services. They allow for price discovery, imposing order and coherence on a mass of individual transactions and making markets visible.[90] They also reduce the costs associated with contracting by providing a simple benchmark that can serve as a price term.[91] In effect, they operate as key technologies for making prices—part of the basic infrastructure supporting markets, and, by extension, the global economy. Given their importance, it is remarkable how little we know about them—how they are made, how they are used, and how they can be manipulated.[92]

Various types of price indices and benchmarks have been used in the oil and gas industry since the early twentieth century. The oil

88. *See* Donald J. MacKenzie, *What's in a Number?*, 30 LONDON REV. BOOKS 11, 11 (2008) ("Judged by the amount of money directly dependent on it, the British Bankers' Association's London Interbank Offered Rate matters more than any other set of numbers in the world. Libor anchors contracts amounting to some $300 trillion, the equivalent of $45,000 for every human being on the planet. It's a critical part of the infrastructure of financial markets but, like plumbing, doesn't usually get noticed.").

89. *See, e.g.*, Philip Ashton & Brett Christopher, *On Arbitration, Arbitrage and Arbitrariness in Financial Markets and Their Governance: Unpacking LIBOR and the LIBOR Scandal*, 44 ECON. & SOC'Y 188, 197–204 (2015) (recounting LIBOR manipulation). Several popular newspaper and book-length accounts have also covered the LIBOR manipulation scheme. *See, e.g.*, LIAM VAUGHN & GAVIN FINCH, THE FIX: HOW BANKERS LIED, CHEATED, AND COLLUDED TO RIG THE WORLD'S MOST IMPORTANT NUMBER (2017).

90. *See* Rauterberg & Verstein, *supra* note 83, at 13 (explaining the role of price indices in improving markets).

91. *See id.* at 10 ("Financial indices provide an entirely new way to draft a less-than-fully-specified contract: the contracting parties agree to let the index provider decide the price.").

92. A handful of legal academics have investigated the role of price indices and other benchmarks in the financial markets. *See, e.g.*, Adriana Z. Robertson, *Passive in Name Only: Delegated Management and "Index" Investing*, 36 YALE J. ON REGUL. 795, 797 (2019) ("With a few exceptions, most scholars and even market participants do not think too hard about where the indices actually come from. As a result, they have become something of a black box in financial markets."); Gina-Gail S. Fletcher, *Benchmark Regulation*, 102 IOWA L. REV. 1929, 1930–31 (2017) (describing index prices and other benchmarks and their growing importance in financial markets); Andrew Verstein, *Benchmark Manipulation*, 56 B.C. L. REV. 215, 218 (2015) ("[M]arket manipulation is increasingly synonymous with benchmark manipulation."). Commentary on LIBOR has also led inevitably to broader discussions of the need for reform and regulation of various benchmarks. *E.g.*, Bainbridge, *supra* note 87, at 843, 846–49 (discussing various alternatives for reforming LIBOR and arguing that the Wheatley Review proposes a stronger ex post governance regime are politically viable and likely to enhance LIBOR's credibility); Rauterberg & Verstein, *supra* note 83, at 57–61 (arguing for stronger intellectual property rights in financial benchmarks such as LIBOR); Fletcher, *supra*, at 1969–70 (proposing an ex ante regulatory framework for financial benchmarks).

markets, in particular, grew up on the basis of a system of posted prices for crude oil at particular locations and, more recently, have come to depend upon a handful of global benchmarks for various grades of crude oil (e.g., West Texas Intermediate, Brent, Dubai-Oman).[93] In natural gas, use of price indices was less widespread in the early twentieth century in part because the markets were much less mature than those for oil and because of a more extensive regulatory scheme. In the 1940s, for example, the Federal Power Commission actually prohibited the use of price indices in natural gas contracts, and from the mid-1950s to the early 1980s, price indices were non-existent due to direct regulation of wellhead sales of natural gas.[94] Beginning in the 1980s, however, as wellhead sales were

93. *See* BASSAM FATTOUH, AN ANATOMY OF THE CRUDE OIL PRICING SYSTEM 30–35 (2011) (discussing role of price reporting agencies and price indices in oil markets).

94. *See* Carver, *supra* note 78, § 10.02 (describing early history of natural gas price indices). Direct regulation of wellhead sales of natural gas was the result of the disastrous 1954 Supreme Court decision, *Phillips Petroleum Co. v. Wisconsin*, holding that wellhead sales did not fall under state-regulated "production and gathering" activities but were instead "sales for resale" under the Natural Gas Act and that the Federal Power Commission was therefore required to establish rates for such sales in interstate commerce. 347 U.S. 672 (1954). Three Justices dissented (Douglas, Clark, and Burton), and Justice Jackson did not take part in the decision. Phillips Petrol. Co. v. Wisconsin, 347 U.S. 672, 677, 681 (1954). As various commentators have observed, the decision created huge distortions in the natural gas industry and placed an impossible administrative burden on the Federal Power Commission to engage in cost-of-service ratemaking for thousands of natural gas producers across the United States. *See, e.g.*, STEPHEN G. BREYER & PAUL W. MACAVOY, ENERGY REGULATION BY THE FEDERAL POWER COMMISSION 68 (1974) ("In 1954 there were more than 5,000 [natural gas] producers, and by 1960 more than 2,900 applications for increased rates were awaiting FPC action. The individual case approach to regulation required findings on costs, including joint costs attributable to gas, and on the allowable rate of return and rate base for the hundreds of companies involved in the 2,900 suspended applications. This would have taken an intolerable amount of time. The decision in the first producer case—the *Phillips* case—took 82 hearing days, and 235 exhibits and 10,626 pages of testimony went into the record. . . . By 1960 the Federal Power Commission had completed only 10 of these cases."). *Phillips* was a straightforward statutory interpretation case and one that, in the era of *Chevron* deference, would almost certainly have come out the other way. *See* 347 U.S. at 690 (Douglas, J., dissenting) ("The fastening of rate regulation on this independent producer brings 'the production or gathering of natural gas' under effective federal control, in spite of the fact that Congress has made that phase of the natural gas business exempt from regulation. The effect is certain to be profound." (emphasis omitted)); *see also* Edmund W. Kitch, *Regulation of the Field Market for Natural Gas by the Federal Power Commission*, 11 J.L. & ECON. 243, 255 (1968) ("Reaching a result required neither by the legislative history nor the language of the statute, the Court gave no reason for the regulation."); BREYER & MACAVOY, *supra*, at 94 ("The court did not examine, more than superficially, the economic purposes that producer regulation might serve. Without such an examination, the court could not tell whether producer regulation was a consistent application of economic policy, in the sense of being

deregulated, price indices emerged as important features of natural gas markets.[95]

Since that time, price indices have become central to U.S. natural gas markets. The objective of these indices is to provide an accurate representation of fixed-price transactions at particular geographic locations.[96] Today, price indices are published for more than one hundred locations around the country,[97] and typically distinguish

consistent with regulation of 'monopoly' distribution companies in the gas industry. If producer regulation did not further economic policy, then to assume a congressional intent to regulate in the face of ambiguous statutory language and un uncertain legislative history was not warranted.").

95. Congress began the process of de-regulating wellhead sales of natural gas with the Natural Gas Policy Act of 1978 (NGPA). Natural Gas Policy Act of 1978, Pub. L. 95-621, 92 Stat. 3351 (1978); *see also* Regulation of Natural Gas Pipelines After Partial Wellhead Decontrol, 50 Fed. Reg. 42,408, 42,411 (Oct. 18, 1985) FED. ENERGY REGUL. COMM'N, Order No. 436 (to be codified at 18 C.F.R. pts. 2, 157, 250, 284, 375, 381) [hereinafter Order 436] ("In essence, sections 601 and 121 of the [Natural Gas Policy Act] effected a phased partial reversal of the Supreme Court's 1954 decision in the *Phillips* case. . . . These statutory changes reflect a Congressional determination that producers of natural gas do not have 'natural' monopoly power. In other words, the statute reflects the workably competitive nature of the production industry." (footnotes omitted)). According to some observers, the NGPA may have made things worse, but it did signal a Congressional willingness to get the federal government out of the business of regulating wellhead sales. *See* Richard J. Pierce, Jr., *Natural Gas Regulation, Deregulation, and Contracts*, 68 VA. L. REV. 63, 63 (1982) (arguing that the NGPA's "slow, multiphase deregulation process has the potential to create significant problems in the natural gas market through its interaction with the provisions of long-term gas supply contracts"). And markets for natural gas did develop, quite robustly in some cases, in the wake of the NGPA. As one indicator of this, the first price index for natural gas was published in 1983 in the Natural Gas Market Newsletter. *See* Harpole, *supra* note 78, § 14.05 ("The first index price table for the competitive market was published in 1983 in the Natural Gas Market Newsletter."). As FERC then began to impose open access requirements on natural gas pipelines, Congress finished the job of deregulating wellhead sales in 1989 with the Wellhead Decontrol Act, which removed price regulation for most wholesale sales of natural gas. *See* Natural Gas Wellhead Decontrol Act of 1989, Pub L. 101-60, 103 Stat. 157 (1989). Going forward, FERC's jurisdiction over wholesale sales of natural gas was limited to sales of domestic gas by pipelines, local distribution companies, or their affiliates. *Id.*

96. *See generally* S&P GLOBAL PLATTS, METHODOLOGY AND SPECIFICATIONS GUIDE US AND CANADA NATURAL GAS 2 (2020), https://www.spglobal.com/platts/plattscontent/_assets/_files/en/our-methodology/methodology-specifications/us_canada_natural_gas.pdf [https://perma.cc/VRE9-3BY6].

97. *See S&P Global Platts & Intercontinental Exchange (ICE) to Improve Natural Gas Price Transparency and Bolster North America Benchmarks: Anonymized ICE Data to Further Underpin Platts Natural Gas Indices*, S&P GLOB. PLATTS (Nov. 21, 2016), https://www.spglobal.com/platts/en/about-platts/media-center/press-releases/2016/112116-amp-intercontinental-exchange-ice-to-improve-natural-gas-price-transparency-and-bolster-north-america-benchmarks [https://perma.cc/Y4UQ-MTWM]; *Who We Are*, NAT. GAS INTEL., http://www.naturalgasintel.com/about

between daily, weekly, and monthly delivery terms.[98] Although as many as ten different entities publish natural gas price indices of one sort or another, two index publishers—Platts and Natural Gas Intelligence (NGI)—are by far the most important.[99]

While the details involved in calculating price indices vary by publisher (and are not fully known), Platts' publicly available information on its methodology offers a reasonable framework for understanding the basic approach.[100] Index publishers operate on the basis of long-standing relationships with market participants who voluntarily report their transactions to the publishers.[101] Platts' daily indices, for example are based on reports of fixed-price physical deals completed before 1 p.m. Central Time for next-day delivery to pipelines in North America.[102] Its monthly index is based on fixed-price physical deals negotiated on any of the last five business days for each month—what is known as "bidweek"—and negotiated for next-month delivery.[103]

After collecting the transaction data, the publisher sorts it and performs various tests to analyze its quality.[104] Anomalous trades are identified and overall liquidity is evaluated at each trading location before constructing and publishing an index.[105] Throughout the process, there is ample room for the exercise of discretion and judgment on the part of those responsible for constructing the indices—a point that has been made with respect to other indices as well and one that argues strongly against the view that these are merely technical

[https://perma.cc/LET9-9TNG] (noting that Natural Gas Intelligence provides price indices for more than 170 locations). Platts publishes natural gas price indices for 109 daily locations and 90 monthly locations. S&P GLOBAL PLATTS, *supra* note 96.

98. S&P GLOBAL PLATTS, *supra* note 96.

99. Platts has been used as a pricing reference for energy contracts since 1928 and launched its first U.S. gas spot price index in 1988. *A Historical Perspective*, S&P GLOB. PLATTS, https://www.spglobal.com/platts/en/about-platts/our-history [https://perma.cc/2GGC-TJ54]. NGI has published daily and weekly natural gas price indices since 1988 and 1993, respectively. Other index developers include: Argus Media, Inc.; Bloomberg L.P.; Btu/Data Transmission Network; Dow Jones and Company; Energy Intelligence Group; Intelligence Press, Inc. (NGI); Intercontinental Exchange, Inc. (ICE); IO Energy LLC; and Powerdex, Inc.

100. S&P GLOBAL PLATTS, *supra* note 96.

101. *Id.* at 2–3.

102. *Id.* at 5.

103. *Id.* at 4.

104. *Id.* at 5.

105. *Id.* at 5–6.

exercises.[106] From their relationships with market participants to their evaluation and weighting of individual transactions to their decision whether to go forward and publish an index on the basis of limited data, the people in charge of constructing these indices hold enormous power in their hands.[107] They can literally move markets.

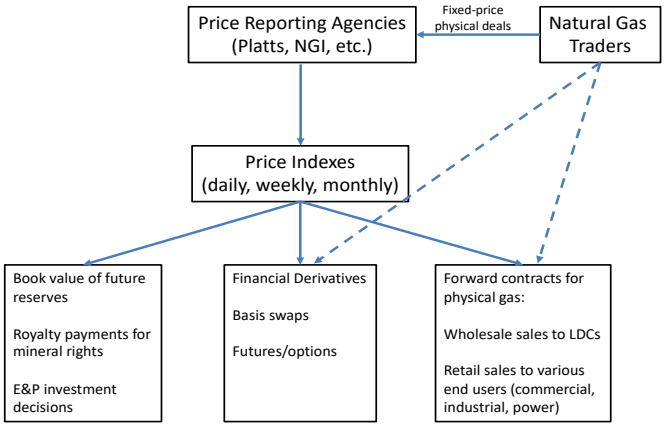

Figure 1: Price Making in Natural Gas Markets

This diagram illustrates price making in U.S. natural gas markets. Traders voluntarily report details of their fixed-price physical natural gas deals to the Price Reporting Agencies who then use that information to construct price indices for specific locations and durations. Specific price indices are in turn used as price terms or for valuation purposes in various related transactions and investments, including some in which the natural gas traders also participate.

It would be difficult to overstate the importance of these indices to natural gas markets. They serve as benchmarks for a whole range of transactions and investment decisions across the industry (see Figure 1).[108] On the transactional side, FERC reports that 82% of the volume of physical natural gas sales that are required to be reported to the Commission are now priced at index.[109] This includes virtually all forward purchases of physical gas by local distribution companies and

106. *See* JOHNSON, *supra* note 76, at 104–21 (discussing methodologies used to establish commodity benchmarks).

107. S&P GLOBAL PLATTS, *supra* note 96, at 5.

108. *See* Verstein, *supra* note 92, at 217 (discussing how benchmarks of various types are "hardwired" into legal relationships).

109. CORNERSTONE RSCH., CHARACTERISTICS OF U.S. NATURAL GAS TRANSACTIONS: INSIGHTS FROM FERC FORM 551 SUBMISSIONS AS OF JULY 3, 2020, at 14 (2020).

other end users such as industrial facilities, power plants, and large commercial operations.[110] Financial basis contracts and other derivatives are also often settled against an identified price index.[111] Natural gas producers utilize price indices to book the value of future reserves.[112] Royalty payments to mineral rights holders and others are typically tied to price indices.[113] And investment decisions regarding exploration and development are often made on the basis of price indices.[114] In short, natural gas price indices play a huge role in the industry, affecting many billions of dollars in transactions and capital investment decisions.[115] Maintaining confidence in the integrity of these indices, therefore, is critical to ensuring that natural gas markets continue to function smoothly.

B. INDEX MANIPULATION

Index manipulation is relatively easy to understand but difficult to detect.[116] In its most basic form, a market participant reports false information to the index publisher, thus skewing the index in a

110. *See* FED. ENERGY REGUL. COMM'N, NO. PL03-3-004 (2004) ("Natural gas producers, local distribution companies (LDCs), and others tend to buy at index-linked prices in lieu of negotiating fixed prices. LDCs have found index pricing to be a straightforward means of meeting prudence reviews by state regulators through comparisons to index benchmarks.").

111. *See* Thomas N. Russo, *Using Natural Gas Price Indices*, 34 NAT. GAS & ELEC. 1, 5 (2017).

112. *See* Harpole, *supra* note 78, § 14.05.4 ("Natural gas producers also utilize index prices to book the value of future reserves. Additionally, index prices are used to pay royalty and overriding royalty owners, as well as to make exploration and developmental drilling decisions.").

113. *See id.*; *see also Natural Gas Indices: Responding to a "Crisis of Confidence,"* 20 NO. 1 NAT. GAS. CONT. NEWSL. 1, 17 (2004) (noting that natural gas price indices are used for the calculation of natural gas royalty payments and severance taxes); *see also* Craig Carver, *Natural Gas Price Indices: Do They Provide a Sound Basis for Sales and Royalty Payments?*, 42 ROCKY MTN. MIN. L. INST. 10, § 10.01 (1996) (discussing widespread use of natural gas price indices as a basis for royalty payments).

114. *See supra* note 112.

115. As one close observer of the industry noted in the wake of the crisis, "[n]atural gas price indexes are the 'Achilles Heel' of a multi-billion-dollar-a-week industry." *See* Harpole, *supra* note 78, § 14.01.

116. *See, e.g.*, Fletcher, *supra* note 92, at 1962 ("[B]enchmark manipulation (1) is difficult to detect in the absence of monitoring; (2) stems from the innately conflicted structure of the benchmark production process; and (3) can have serious consequences for market stability . . . ."); Verstein, *supra* note 92, at 218 ("By their nature, benchmarks describe a market based on some small slice of it. Careful manipulators can bias that slice. It is daunting to corner the world currency market, but it is less daunting to corner the two percent of the market whose price is considered by the leading benchmark.").

manner that will benefit the market participant's position in a connected transaction or market.[117] But indices can also be manipulated through means other than false reporting: trading strategies and selective reporting of information, for example, can move an index even though neither involves misrepresentation. Depending on the volume of transactions tied to any particular index, small changes in a price index can result in large impacts.[118] The LIBOR manipulation scandal that first came to light in 2012, for example, affected trillions of dollars in consumer loans, currency exchanges, and a whole host of other transactions tied to the index.[119] Likewise, even a very small change in the wholesale natural gas price as a result of an index manipulation scheme would ripple through the markets affecting billions of dollars in natural gas transactions and investment decisions. These index prices are quintessential examples of what two scholars have referred to as "systemically significant" prices.[120]

Market participants and others have long been aware of the possibility of index manipulation. One close observer of the use of price indices in the petroleum industry during the 1950s, for example, described the obvious incentives for manipulation:

> It would appear on the surface at least that there might be some opportunities in a price mechanism such as this [Platt's *Oilgram*] for price rigging by those interested in keeping prices low. Assuming that contract prices are based on the low of the *Oilgram*, the *Journal*, or any other price-reporting medium, there is no question but that net buyers might gain from a decrease in the low quotation. If the net buyer were to unload an occasional cargo at a price below the low, he would, by so doing, establish a new low and if he were then to offset that sale by buying something in excess of the amount sold, he would enjoy a net gain on the combination of transactions.[121]

The author goes on to note, however, that "[w]hile this is possible in the abstract it would be difficult to effect, even assuming a company might be interested in attempting it."[122] This was because "[a]ny such

117. *See* Darrell Duffie & Jeremy Stein, *Reforming LIBOR and Other Financial Benchmarks*, 29 J. ECON. PERSP. 191, 194 (2015) ("Clearly, if one of the counterparties to a trade also plays a role in the fixing method that determines the announced benchmark price, the incentive to manipulate is especially severe.").

118. *See id.* at 200 (explaining that small distortions can still be lucrative to the manipulating party).

119. *See* Fletcher, *supra* note 92, at 1931 (explaining that the 2012 LIBOR scandal affected the price indices, which deals with an "estimated outstanding notional value of $220 trillion").

120. *See* Robert C. Hockett & Saule T. Omarova, *Systemically Significant Prices*, 2 J. FIN. REGUL. 1 (2016).

121. RALPH CASSADY, JR., PRICE MAKING AND PRICE BEHAVIOR IN THE PETROLEUM INDUSTRY 149 (1954).

122. *Id.*

attempt would be perfectly apparent to the price-reporting experts" and other market participants would no longer trade with the would-be manipulator.[123]

During the 1980s and 1990s, as it worked to restructure the natural gas industry, FERC seemed unaware of the possibility of price index manipulation. Although FERC's major restructuring order—Order 636—discussed the importance of promoting market centers and pooling areas, it said nothing about price indices.[124] Throughout its restructuring effort, in fact, FERC never focused on price indices in any serious way. In its first major restructuring order, Order 436 issued in 1985, the Commission emphasized the importance of "[a]ccurate, responsive price signals" in allowing markets to develop.[125] The Commission also pointed to the "explosive growth" of the spot market over "a few short years" and identified the role of trade publications in "following prices and market developments" as evidence of healthy and maturing market.[126] But neither Order 436 nor any of FERC's other restructuring orders identified price indices as objects of inquiry or concern.[127] And there was almost no commentary at the time on potential problems with these indices.[128]

In effect, FERC seemed to assume that price indices, like market centers and pooling areas, were natural features of the emerging

123. *Id.* at 149–50. Price index manipulation has been the subject of antitrust litigation for decades. *See, e.g.*, United States v. Socony-Vacuum Oil Co., 310 U.S. 150, 221 (1940) ("Any combination which tampers with price structures is engaged in unlawful activity."); Oneok, Inc. v. Learjet, Inc., 575 U.S. 373, 384 (2015) (holding that state antitrust action stemming from natural gas price index manipulation was not preempted by Natural Gas Act).

124. *See* Order 636, *supra* note 15 (discussing market centers and pooling areas).

125. *See* Order 436, *supra* note 95, at 42,414. FERC went on to note that such price signals are "not a matter for mere academic concern but a matter of commercial life and death for the production industry." *Id.*

126. *Id.* at 42,420; *see also id.* at 42,412 (observing that the natural gas industry in the United States was marked by a "highly competitive and rapidly growing spot market, with a thriving infrastructure of brokers and marketers, electronic information exchange services, and trade publications tracking price and market movements"). Between 1982 and 1987, for example, the Energy Information Administration (EIA) estimated that spot market volumes traded in the United States grew from 0.22 trillion cubic feet to 7.22 trillion cubic feet. Michael J. Doane & Daniel F. Spulber, *Open Access and the Evolution of the U.S. Spot Market for Natural Gas*, 37 J.L. & ECON. 477, 485 (1994) (citing EIA figures).

127. *E.g.*, Order 436, *supra* note 95, at 42,408.

128. A survey of legal periodicals has found only one detailed treatment on natural gas price indices prior to the California Energy Crisis of 2000–01: a 1996 article by a practicing oil and gas lawyer from Denver, Colorado, that addressed the use of natural gas price indices as a basis for sales and royalty payments. *See* Carver, *supra* note 78.

landscape of natural gas markets. Price indices, in other words, were viewed as evidence of the continuing maturity and health of these markets rather than as potential targets of manipulation. This largely passive view of such a critical instrument of price making would prove to be naïve, a product of an overly simplistic, naturalized understanding of markets compounded by a lack of critical information about market conditions and the behavior of key market participants.

All of this changed with the California energy crisis of 2000–01, which involved severe disruption of natural gas and electricity markets across California and the western United States as a result of manipulation, poor market design, and limited oversight.[129] Subsequent investigations by FERC and others revealed that false reporting to natural gas price indices during the crisis was, in FERC's words, "epidemic."[130] In addition, some traders engaged in extensive "churning" (i.e., rapid buying and selling of natural gas at a particular location) to create the illusion of market activity and drive indices higher.[131] Together, these activities resulted in significant increases in spot gas prices, in published price indices, and in electricity prices—all of which translated into several billion dollars in excessive payments by California consumers of natural gas and electricity.[132]

During the investigation, five companies admitted that their employees provided false data to price index publishers.[133] But FERC staff also found that index manipulation was common throughout the

129. *See generally* FINAL REPORT, *supra* note 17 (reporting on results of FERC investigation into the California energy crisis).

130. *See id.* at ES-6 ("Market participants provided false reports of natural gas prices and trade volumes to industry publications. These publications used the reports to compile price indices, and false reporting became epidemic. . . . The false reporting included fabricating trades, inflating the volume of trades, omitting trades, and adjusting the price of trades. . . . Many traders acknowledged that false reporting was done openly in the industry.").

131. *Id.* at II-59 ("Reliant's churning had the effect of moving the entire market price [of natural gas] by an average of some $8.54/MMBtu for December 2000 and by an average of $1.91/MMBtu over the 8-month period that it churned."); *see also id.* at II-30 to -31 (describing how Reliant's churning raised index prices).

132. *Id.* at II-59 to -60 (estimating that as a result of Reliant's churning activities, SoCalGas's customers "paid excessive gas costs in the neighborhood of $650 million for December 2000 and about $1.15 billion for the 8-month period" that Reliant churned and that these excessive gas prices in turn inflated electric clearing prices by about $1.6 billion); *see also* WEARE, *supra* note 17, at 3–4 (estimating $40 billion in excess energy costs and $40–45 billion in total costs as a result of the California energy crisis).

133. *Id.* at III-4 (listing Dynegy, AEP, Williams, CMS, and El Paso as the five companies).

industry, extending far beyond these five companies.[134] And the behavior went on for years.[135] According to FERC, it was common knowledge in the industry that most market participants engaged in false reporting to price indices: "because everyone knew that everyone else was manipulating the indices by reporting false prices and volumes, it was somehow acceptable and even necessary for this to take place."[136] Incredibly, one argument advanced in defense of the price indices maintained that because the manipulations went in both directions, they would be "offsetting" and the resulting indices could therefore be considered accurate.[137] Needless to say, FERC staff were not persuaded.[138]

Part of the problem stemmed from the fact that most of the major natural gas trading companies "had no formal process for reporting trade data to the publishers of the price indices; the process was left to the trading desks and to the traders themselves."[139] In effect, nobody was paying attention.[140] Quality control systems did not exist.[141] And conflicts of interest were endemic.[142] Some of this, not surprisingly, was easy to fix, and natural gas trading companies responded quickly by adopting improved practices, internal controls and audits, and better oversight.[143]

But some of it was not so easy to fix. For starters, FERC had no regulations expressly prohibiting any of these activities. Indeed, as FERC concluded in its final report on the western energy crisis, none of these activities violated the Commission's regulations because those regulations did not contain "explicit guidelines or prohibitions for trading gas" or reporting to indices.[144] Moreover, the Commission

134. *Id.* at III-29 ("[T]he industry lacked systematic reporting procedures and internal verification processes. . . . [T]he price manipulation goes beyond the five companies that have admitted to such behavior.").

135. *Id.* at III-37 ("[S]ystematic attempts to manipulate the published price indices by various significant market participants occurred for at least 4 years.").

136. *Id.* at III-15.

137. *Id.* at III-16.

138. As the report concluded: "Staff does not find this argument to be persuasive." *Id.*

139. *Id.* at III-29.

140. *See id.*

141. *See id.*

142. *Id.* at VII-15.

143. *Id.* at III-38 to -43 (discussing efforts by natural gas trading companies to reform their price reporting activities).

144. *See id.* at II-61 ("Reliant's churning did not violate Section 284.402 of the Commission's regulations because those regulations contain no explicit guidelines or prohibitions for trading gas.").

had limited ability to force market participants and/or price index publishers to disclose specific information.[145] Nor did it really seem to understand how these indices were constructed and the roles they played in the markets.

In sum, the California crisis revealed that price indices were hardly the simple reflections of the market that FERC and others had assumed they were (to the extent that they even thought about them) before the crisis. In fact, they were key instruments of price making and, as a result, ideal targets for manipulation. Since the California crisis, the Commission has been much more proactive in its efforts to police against natural gas price index manipulation, litigating or securing settlements in multiple cases.[146] But there are limits to such an approach, given the opacity of the indices themselves and the fact that index manipulation does not always involve overt fraudulent activity such as misreporting.[147] In short, FERC's recognition of the constitutive role that these indices play in making prices and, by extension, their potential for manipulation was only a first step. Determining how, if at all, to regulate these price indices continues to prove quite challenging.

C. PRICE FORMATION AND FERC'S TRANSPARENCY PROBLEM

Much of the post-crisis analysis and calls for reform at FERC have focused on improving transparency in price indices and ensuring that market participants adhere to basic standards in their reporting.[148] Over the last decade, as FERC has come to recognize the importance of price formation and the fundamental role that the price indices play in the natural gas markets, it has pursued multiple efforts to safeguard the credibility of these indices and to generate a more complete picture of the natural gas markets.[149] To date, however, none of these

145. *See* U.S. GEN. ACCT. OFF., *supra* note 68, at 7 (explaining FERC's limited authority "to levy civil penalties").

146. *See* FED. ENERGY REGUL. COMM'N, *supra* note 68, at 21–23 (describing five separate cases involving natural gas price index manipulation since 2005).

147. There are also jurisdictional issues here that preclude FERC from enforcing against certain cross-market manipulation schemes that originate in the financial markets. *See* Hunter v. Fed. Energy Regul. Comm'n, 711 F.3d 155, 156 (D.C. Cir. 2013) (finding that CFTC has exclusive jurisdiction over manipulation schemes involving natural gas futures contracts).

148. *See, e.g.*, Enhanced Natural Gas Market Transparency, *Notice of Inquiry*, 141 F.E.R.C. ¶ 61,124 (Nov. 15, 2012) FED. ENERGY REGUL. COMM'N No. RM13-1-000 (reviewing FERC's efforts after the California energy crisis to improve transparency in natural gas pricing).

149. *See, e.g.*, Order 704, *supra* note 74.

efforts have resulted in any significant change in FERC's general posture of leaving the oversight and regulation of the indices to third-party index publishers.

Although the index publishers themselves have reformed their internal practices and have endeavored to be more transparent on some aspects of their methodologies, they have never acknowledged even the possibility of FERC jurisdiction and have been unwilling to allow the data underlying their price indices to be audited and verified.[150] The observation of FERC staff in their initial 2002 report on the western energy crisis still holds true today:

> At this point in time, no independent entity, such as this Commission, can verify the published price data. This is due, in part, to the reporting firms' status as non-jurisdictional entities as well as their legitimate desire to protect the confidentiality of their sources. Without knowing the source of the raw data, there cannot be any independent verification of the price data published by any reporting firm.[151]

In fact, Platts and other price reporting agencies have long maintained a position of confidentiality with respect to their sources, making it very difficult for FERC or other regulators to police the integrity of the published indices.[152]

The basic conclusion offered by FERC staff in the wake of the California crisis—that the price reporting "process is fundamentally flawed because the Trade Press data are still not subject to

150. *See, e.g.*, Platts, Comment Letter on Notice of Inquiry Regarding Enhanced Natural Gas Market Transparency, FED. ENERGY REGUL. COMM'N No. RM13-1-000 at 6–9 (Feb. 12, 2013) (arguing against FERC's proposal to require additional information from price reporting agencies as well as mandatory reporting by market participants); *see also id.* at 10 ("Platts firmly believes in voluntary participation in the price formation process. . . . Platts consistently has cautioned that mandatory reporting regimes could induce market participants to opt out of price discovery.").

151. FED. ENERGY REGUL. COMM'N, NO. PA02-2-000, INITIAL REPORT ON COMPANY-SPECIFIC SEPARATE PROCEEDINGS AND GENERIC REEVALUATIONS; PUBLISHED NATURAL GAS PRICE DATA; AND ENRON TRADING STRATEGIES 4 (2002).

152. In the mid-1990s, for example, in response to an inquiry into the methodology used to establish price indices, price reporting agencies such as NGI opposed any effort to review the underlying data and methods used to construct the price indices. "The key to NGI's price survey of the natural gas market is our pledge of confidentiality which is printed as part of our pricing methodology. . . . Since confidentiality is the basis on which the survey operates, it would be impossible to keep verifiable records of our price quotes and still remain in business. Therefore, no true audit of our activities can be made." Carver, *supra* note 78, § 10.04[3]. And here is a comment by McGraw-Hill: "We would oppose any attempt . . . to review the raw data that we use to compile our prices. In principle, that data is no different from a reporter's notes used to write a story, which clearly we would not turn over voluntarily to any outside party." *Id.*

independent verification"[153]—is just as accurate today as it was then. Indeed, "as long as the companies publishing the indices continue to refuse to disclose the actual calculations of the published price indices," FERC staff maintained, "the information chain cannot be audited and the Commission cannot verify the accuracy of the published price indices."[154] Their recommendation to the FERC Commissioners was unequivocal: "only price indices calculated from actual trades that can be verified by the Commission should be used as the basis for any Commission-approved sales of natural gas or electricity."[155] But the Commission balked, and it has never revisited the issue with the conviction needed to reform the ways of price making in natural gas markets.

To be sure, FERC has taken steps to improve transparency and promote confidence in natural gas price indices. Among other things, the Commission has convened a series of technical conferences addressing price formation,[156] issued policy statements recommending standards for index publishers and market participants,[157] and promulgated new regulations establishing mandatory codes of conduct for those making jurisdictional sales of natural gas.[158] According to FERC, these codes of conduct are intended to police against "behavior undertaken without an appropriate commercial underpinning for the purposes of distorting prices that would otherwise occur in the competitive market."[159] Somewhat surprisingly, these regulations did not require jurisdictional sellers to report their transactions to price indices.[160] But any jurisdictional seller that does report is required to "provide accurate and factual information, and not knowingly submit

153. FINAL REPORT, *supra* note 17, at III-48; *see also id.* ("In order for the published indices to be reliable, there must be a way to audit the entire information chain.").

154. *Id.* at III-49.

155. *Id.*

156. *See* sources cited *infra* notes 171, 180. FERC also encouraged the industry to articulate a set of "best practices" for price indices that resulted in a 2003 white paper by the Committee of Chief Risk Officers on Best Practices for Energy Price Indices. *See* FED. ENERGY REGUL. COMM'N, *Order Further Clarifying Policy Statement on Natural Gas and Electric Price Indices*, 112 FERC ¶ 61,040 (July 6, 2005) para. 8–16 (discussing Committee of Chief Risk Officers white paper).

157. *See* FED. ENERGY REGUL. COMM'N, NO. PL03-3-000, PRICE DISCOVERY IN NATURAL GAS AND ELECTRIC MARKETS, POLICY STATEMENT ON NATURAL GAS AND ELECTRIC PRICE INDICES 9–12 (2003) (detailing "minimum standards" for index publishers and for market participants reporting to the indices).

158. *Amendments to Blanket Sales Certificates*, Order No. 644, 68 Fed. Reg. 66,323 (Nov. 26, 2003) (to be codified at 18 C.F.R. pt. 284).

159. *Id.* at 66,328.

160. *Id.* at 66,332 ("At this time, we are not mandating reporting.").

false or misleading information or omit material information to any [index] publisher."[161] In response to concerns that this would chill reporting, FERC has established safe harbor protections for inadvertent mistakes in reporting.[162]

Congress also added new provisions to the Natural Gas Act in 2005 that specifically addressed market manipulation, transparency, and price indices. New section 4A of the Natural Gas Act, for example, imported the basic securities fraud framework to prohibit market manipulation in natural gas markets.[163] New section 23 directed the Commission "to facilitate price transparency in markets for the sale or transportation of physical natural gas in interstate commerce" and provided that the Commission may obtain "information about the availability and prices of natural gas sold at wholesale and in interstate commerce" from "any market participant."[164] In carrying out its new responsibilities under this provision, FERC is required to "consider the degree of price transparency provided by existing price [index] publishers" and to "rely on such publishers to the maximum extent possible."[165] But if the Commission determines that the existing indices "are not adequately providing price discovery or market transparency," it can establish its own electronic information system.[166]

Pursuant to this new authority, FERC issued a pair of regulations in 2008 intended to provide more visibility into the workings of the natural gas market.[167] In essence, these new regulations required market participants to file annual reports on their wholesale transactions of physical natural gas and required intra-state pipelines to

161. *Id.* at 66,336.

162. *Id.* at 66,631.

163. Natural Gas Act § 4A, 15 U.S.C. § 717c-1. FERC adopted regulations on market manipulation in 2006. *See Prohibition on Energy Market Manipulation*, Order No. 670, 71 Fed. Reg. 4244 (Jan. 26, 2006) (to be codified at 18 C.F.R. pt. 1c). *But see* David B. Spence & Robert Prentice, *The Transformation of American Energy Markets and the Problem of Market Power*, 53 B.C. L. REV. 131, 133 (2012) ("[B]y focusing on fraud and deceit, the securities regulation model misses ways in which sellers of energy in physical markets can exercise market power at the expense of buyers, even in the absence of fraudulent or deceptive conduct.").

164. Natural Gas Act § 23, 15 U.S.C. § 717t-2 (2005).

165. *Id.*

166. *Id.*

167. *See* Order 704, *supra* note 74 (requiring certain market participants to deliver annual reports to FERC); *Pipeline Posting Requirements Under Section 23 of the Natural Gas Act*, Order No. 720, 73 Fed. Reg. 73,494 (Nov. 20, 2008) (requiring "major non-interstate gas pipelines" to make daily postings for daily scheduled volume for certain points).

submit information about the volume of gas shipped on their systems.[168] According to the Commission, the new rules would instill confidence in the markets by making price formation more transparent. "Without confidence in the basic processes of price formation," the Commission noted, "market participants cannot have faith in the value of their transactions, the public cannot believe that the prices they see are fair, and it is more difficult for the Commission to ensure that jurisdictional prices are 'just and reasonable.'"[169]

But FERC lost the ability to use these rules to their full effect when the Fifth Circuit rejected the intrastate pipeline regulations.[170] Moreover, the annual trading reports have proved to be far too general to assess market conditions in a timely manner.[171] FERC thus issued yet another proposal in 2012 to require more detailed and frequent reporting on natural gas transactions by jurisdictional sellers.[172] According to the Commission, better reporting would "facilitate price transparency in the natural gas market by enabling buyers and sellers of natural gas to better understand the trading and prices that contribute to the daily and monthly indices."[173] This would in turn help to ensure that prices in the natural gas markets are the "result of fundamental supply and demand forces and not the result of manipulation or other abusive market conduct."[174]

The responses to FERC's new proposal were almost uniformly negative. Because of jurisdictional limits, commenters argued, the new information would not be representative of the market as a whole.[175] In addition, public dissemination of detailed information on

168. *See* sources cited *supra* note 167.

169. *Transparency Provisions of Section 23 of the Natural Gas Act; Transparency Provisions of the Energy Policy Act*, 72 Fed. Reg. 20,791, 20,792 (Apr. 19, 2007) (to be codified at 18 C.F.R. pts. 260, 264).

170. *See* Tex. Pipeline Ass'n v. Fed. Energy Regul. Comm'n, 661 F.3d 258, 263 (5th Cir. 2011) ("[T]he NGA unambiguously precludes FERC from issuing the Posting Rule so as to require wholly intrastate pipelines to disclose and disseminate capacity and scheduling information.").

171. *See* Enhanced Natural Gas Market Transparency, *Notice of Inquiry*, 141 F.E.R.C. ¶ 61,124 (Nov. 15, 2012) FED. ENERGY REGUL. COMM'N No. RM13-1-000 at 9 ("[T]he information that is currently available does not provide full market visibility or price transparency. Much of the data that is currently available is aggregated and does not provide transaction-specific details.").

172. *See id.*

173. *Id.* at 11.

174. *Id.* at 11–12.

175. *See, e.g.*, American Forest & Paper Association, Inc., et al., Comment Letter on Notice of Inquiry Regarding Enhanced Natural Gas Transparency, 77 Fed. Reg. 69,781 (Nov. 15, 2012) FED. ENERGY REGUL. COMM'N No. RM13-1-000 at 8–9 (Feb. 12, 2013).

specific transactions might have anticompetitive effects.[176] For its part, Platts argued that the information FERC was seeking from market participants and price reporting agencies was akin to the information that would be provided by the "electronic information system" identified in Section 23 of the Natural Gas Act.[177] As a result, Platts continued, FERC would have to make a threshold determination that the existing price publishers were not "adequately providing price discovery or market transparency" before requiring this additional reporting.[178]

But this argument simply begs the question of how FERC is supposed to evaluate the markets in order to make such a determination of adequacy if it cannot see what is actually going on in the markets. And because Platts and other price index publishers have continued to assert First Amendment protections over the data they use to construct their price indices, FERC has been unable to see what is actually going on in the markets. Nonetheless, FERC terminated this new proceeding in 2015, leaving it to rely upon the limited annual reporting required under existing regulations.[179] Although the Commission convened another technical conference on the health of natural gas price indices in June 2017, there is no indication that FERC is planning to change its current approach.[180] In retrospect and notwithstanding a substantial effort stretching over more than a decade, FERC has made little progress in improving the overall transparency of the natural gas markets and getting a better handle on the crucial role that price indices play in those markets.

And there is some urgency here. Based on the information that FERC does collect as well as reports in the trade press, the volume of transactions being reported to the index publishers is declining, while the volume of gas that is tied to the indices is increasing.[181] As of 2019,

176. *See* U.S. Department of Justice, Comment Letter on Notice of Inquiry Regarding Enhanced Natural Gas Market Transparency, 141 F.E.R.C. ¶ 61,124 (Feb. 1, 2013) FED. ENERGY REGUL. COMM'N No. RM13-1-000 at 1–2 (Nov. 15, 2012).

177. *See* Platts, Comment Letter on Notice of Inquiry Regarding Enhanced Natural Gas Market Transparency, FED. ENERGY REGUL. COMM'N No. RM13-1-000 at 6–9 (Feb. 12, 2013).

178. *Id.*

179. Enhanced Natural Gas Market Transparency, Order Terminating Proceeding, 153 F.E.R.C. ¶ 61,174 (Nov. 17, 2015) FED. ENERGY REGUL. COMM'N No. RM13-1.000.

180. *See* FERC, *Technical Conference on Developments in Natural Gas Index Liquidity and Transparency*, Docket No. AD17-12-000, June 29, 2017.

181. *See, e.g.*, CORNERSTONE RSCH., *supra* note 109, at 14–16 (reporting that in 2019 the volume of transactions reported to the indices continued to decline while the volume of transactions dependent upon the indices continued to increase); *see also* Alexander Osipovich, *U.S. Gas Reporting Drop Raises Questions About Indices*, ENERGY RISK

the ratio of natural gas priced at index to fixed-priced deals used to form the indices was more than 12-to-1, a substantial increase from 2008 when the ratio was 3.6-to-1.[182] While it is hard to know the precise reasons for this, some have pointed to a perception of increased regulatory risk for misreporting, despite FERC's efforts to create safe harbors and clear guidelines.[183] Others have suggested that because of lower price volatility as a result of the massive expansion of shale gas production since 2008, many market participants find it easier to rely upon the price indices rather than negotiate fixed-price deals.[184] Whatever the reason, ongoing decline in the volume of transactions used to support the indices threatens to further undermine confidence in the indices themselves and, in turn, could hamper the functioning of natural gas markets.[185] Declining liquidity could also exacerbate the potential for manipulation by giving those entities that continue to report more influence over the index. While this may not seem to matter much in the current environment of low natural gas prices, no one wants to see a return to the market disruptions of the past.[186] And, of course, index manipulation is problematic (and illegal) in any price environment.

Although FERC surely recognizes this, the Commission has so far been unwilling to impose more oversight on the indices to ensure that

(Aug. 13, 2015), https://www.risk.net/commodities/energy/2421133/us-gas-price-reporting-drop-raises-questions-about-indexes (noting that price reporting agencies "are constructing their indices based on a shrinking proportion of reported trades, yet the share of deals linked to their price assessments is growing").

182. CORNERSTONE RSCH., *supra* note 109, at 16.

183. *See, e.g.*, J. Robinson, *Data Shows Increasing Reliance on Natural Gas Price Indexes*, PLATTS ENERGY TRADER, July 5, 2018 (reporting view of industry professionals that the decline in reporting to price indices "indicates a perception of regulatory risk among market participants and potential price reporters").

184. *See, e.g*, Maya Weber, *FERC Conference Debates Indices' Health, Fixes*, PLATTS GAS DAILY, June 30, 2017 (observing that the shale revolution has created preference for index deals); Joe Fisher, *NatGas Price Index Reporting Sees Uptick*, NAT. GAS INTEL. (Apr. 7, 2017), https://www.naturalgasintel.com/natgas-price-index-reporting-sees-uptick [https://perma.cc/4PHL-LEUZ] ("Lower price volatility in recent years—thanks largely to shale gas abundance—has made fixed price deals less attractive compared with the alternative of just doing index deals.").

185. *See* Dan DeFrancesco, *Turning Up the Heat: Energy Firms Are Urging the Federal Energy Regulatory Commission to Prop Up Illiquid Natural Gas Indices, as a Drop in Price Reporting Is Eroding Confidence*, 30 RISK 71 (2017).

186. *See* Thomas N. Russo, *Using Natural Gas Price Indices*, 34 NAT. GAS & ELEC. 1, 4 (2017) ("Despite the popularity of natural gas [price] indices, many energy analysts take a dim view of them. They argue that sellers and buyers should be analyzing the fundamentals of supply and demand at specific hubs to determine a fair price and not following the crowd. . . . In the low-price environment we are now in, most sellers and buyers are not concerned . . . .").

they have integrity and enjoy the full confidence of market participants. For its part, Platts has taken steps to shore up some of the indices, entering into a deal (effective in October 2017) with the Intercontinental Exchange (ICE) to incorporate data from transactions executed on ICE's physical gas trading platform,[187] something NGI has been doing since 2008.[188] While this may mitigate some of the liquidity problems facing the indices, it still leaves FERC with the question of how, if at all, to regulate them. The exclusive use of ICE data by the two leading index publishers has also raised concerns among some natural gas consumers and other market participants that this gives these two price reporting agencies too much power over critical pricing information in the markets.[189]

As noted in the introduction to this Article, FERC has ample legal authority to regulate these price indices given that the index publishers are quite clearly engaged in "practices" that directly affect jurisdictional rates.[190] Even if the First Amendment protections claimed by the index publishers inhibit FERC from getting direct access to their underlying data and calculations (a question that has yet to be tested fully in court),[191] FERC could require independent audit and verification of such indices. It could also use its section 23 authority to require all market participants in wholesale natural gas markets (not simply

187. *See, e.g*, Alexander Osipovich, *ICE, Platts Shore Up Shaky Natural Gas Indices*, WALL ST. J. (Nov. 21, 2016), https://www.wsj.com/articles/ice-platts-shore-up-shaky-natural-gas-indexes-1479733201 [https://perma.cc/3QJF-B5J3]; *see also* Nat. Gas Intel., No. AD17-12-000, Statement Before FERC: Developments in Natural Gas Index Liquidity and Transparency 2 (July 31, 2017) (discussing NGI arrangement with ICE to use ICE transaction data in developing price indices).

188. *Natural Gas Price Index Data*, NAT. GAS INTEL., https://www.naturalgasintel.com/product/ngi-price-index-data [https://perma.cc/496K-TTAA].

189. *See* Developments in Natural Gas Index Liquidity and Transparency, Post-Technical Conference Comments of Process Gas Consumers Group and American Forest & Paper Association (June 31, 2017) FED. ENERGY REGUL. COMM'N AD17-12-000 at 7 ("With the agreement between Platts North America and Intercontinental Exchange, Platts will be in the position to exercise an unacceptable level of market power over consumers with respect to the price of subscriptions for their publication of natural gas price index information, which end-users rely upon for their pricing information.").

190. *See, e.g.*, Natural Gas Act § 5(a), 15 U.S.C. § 717d(a).

191. In several cases involving investigations by FERC and CFTC of natural gas price index manipulation, courts have rejected assertions of the reporter's privilege by index publishers. *See, e.g.*, CFTC v. McGraw-Hill Cos., 507 F. Supp. 2d 45 (D.C. Cir. 2007) (holding that need for trading data reported to price index publisher by company under investigation overrode reporter's privilege); *In re* Nat. Gas Commodities Litig., 235 F.R.D. 241 (S.D.N.Y. 2006) (finding that qualified reporter's privilege did not immunize trade data found in publications related to the natural gas industry from disclosure). The question of whether courts would find similarly in the absence of a specific investigation has not been litigated.

jurisdictional sellers) to disclose specific transactional data to FERC, including the identity of the indices to which such transactions are reported, as a basis for supporting such audits.[192] Finally, FERC could take the more aggressive step of creating its own electronic information system for price reporting (a public price index) to support these markets if it determined that the existing indices were inadequate—a determination that could, in theory, be based on the general lack of transparency regarding the price indices and the ongoing decline in reported transactions.[193] And even if FERC does not want to go that far, the Commission could limit its findings of inadequacy to specific price indices at certain illiquid trading hubs, which could provide the basis for creating a single or small number of public indices for these problematic hubs. Taking such action would allow FERC to experiment with managing a public index on a limited scale without disrupting the larger natural gas markets, thus providing a valuable opportunity for learning and, perhaps, some useful "yardstick" competition for the existing private indices.[194]

With the exception of establishing a public index, each of these approaches would be relatively easy to implement. For the moment, however, most market participants seem to be content with the status quo, with few clamoring for reform in the way that some did during the mid-2000s when prices were much higher.[195] But the current situation seems untenable over the longer term, and it is clear that FERC needs a fresh approach to the indices. While the views of market participants are clearly important (and FERC deserves substantial credit for creating multiple opportunities for them to make their views known), those views can also be narrow and self-serving, detracting from FERC's overarching duty to protect the broader public interest

192. BP recently argued that FERC should consider mandatory reporting, at least for some hubs that are currently facing liquidity problems. *See* Natural Gas Price Formation, Comments of BP Energy Company, BP Canada Energy Marketing Corp., and IGI Resources, Inc. (June 29, 2017) FED. ENERGY REGUL. COMM'N No. AD17-12-000.

193. As part of its energy reform, Mexico has developed a public price index for natural gas. *See, e.g.*, Kristen Tsai, *Mexico Published First Monthly Natural Gas Price Index After Moving to Competitive Market*, U.S. ENERGY INFO. ADMIN. (Aug. 30, 2017), https://www.eia.gov/todayinenergy/detail.php?id=32712 [https://perma.cc/B6JR-WJR9].

194. *See* Franklin D. Roosevelt, *Government Regulation of Public Utilities*, 30 PROC. AM. ACAD. POL. SCI. 44, 51 (1971) (discussing function of government operated municipal utilities as "yardstick" competition for investor-owned utilities).

195. *See, e.g.*, Russo, *supra* note 111, at 1 (contrasting current situation with 2006 when various trade associations and market participants were "very upset with high natural gas price indices and wanted FERC to do something about it").

by ensuring that natural gas prices are just and reasonable.[196] Simply put, allowing private parties to control pricing information in a market as vital as natural gas raises the question whether FERC is meeting its statutory obligations under the Natural Gas Act to ensure that prices are just and reasonable. With eighty-two percent of physical natural gas sales now tied to price indices that are in turn based on a limited and shrinking number of fixed-price deals involving a small number of large players,[197] there is a premium on making sure that the indices have integrity. Yet, because the indices are controlled entirely by private entities that refuse to make their underlying data available for inspection and audit, there is no real basis for making such a determination. At a minimum, in order to conclude that natural gas prices are just and reasonable, FERC needs to understand how these prices are made.

III. PRICE MAKING IN ELECTRICITY MARKETS

Following its successful effort to restructure the natural gas industry, FERC embarked on the far more ambitious task of restructuring the electricity sector in the 1990s. With some modest help from Congress, the Commission used its authority under the Federal Power Act in new and creative ways to unbundle the industry and create an open access regime for transmission that would in turn provide the foundation for competitive wholesale power markets.[198] Today, organized wholesale power markets operate across much of the country, including the mid-Atlantic, Northeast, Midwest, California, and Texas (which is regulated wholly by the state of Texas).[199] This Part focuses on these organized electricity markets—those that are run by independent system operators (ISOs) and regional transmission organizations (RTOs). In doing so, it looks specifically at the algorithms and auction structures at the center of these markets and the challenges that these ways of price making pose to FERC's ability to ensure that the resulting prices are just and reasonable.

196. Like the Federal Power Act, the Natural Gas Act is founded upon a commitment to the public interest. *See* Natural Gas Act, § 1(a), 15 U.S.C. § 717(a); *see also* Fed. Power Comm'n v. Hope Nat. Gas Co., 320 U.S. 591, 627 (1944) (Frankfurter, J., dissenting) ("Of course the statute is not concerned with abstract theories of ratemaking. But its very foundation is the 'public interest'. . . .").

197. *See* CORNERSTONE RSCH., *supra* note 109, at 14–16.

198. *See* Order 888, *supra* note 15.

199. *See Electric Power Markets*, FED. ENERGY REGUL. COMM'N (June 8, 2020), https://cms.ferc.gov/industries-data/market-assessments/overview/electric-power-markets [https://perma.cc/55W2-PK9K] (information about wholesale powers markets in the United States, including a map).

As with natural gas price indices, FERC did not pay much attention to these ways of price making until after the California electricity crisis. Since that time, FERC has focused extensively on the problems of market manipulation and gaming, using new powers provided by Congress in the Energy Policy Act of 2005. But the problems of price formation in electricity markets do not stem solely from manipulation and gaming. Ongoing controversies in these markets about how to value the attributes of certain resources, how to handle subsidies and other "out-of-market" payments resulting from state and federal policies, and what to do about the increasing supply of zero-marginal cost resources such as wind and solar have dominated recent discussions about market reform in the RTOs and ISOs as well as at FERC. As this Part will show, these challenges raise fundamental questions about the nature and long-term viability of these markets, and point (again) to the ways in which price making technologies themselves have become objects of intense struggle among market participants.

A. AUCTIONS AND ALGORITHMS

The organized wholesale electricity markets in the United States are structured around a series of auctions, which are themselves embedded in a set of algorithms that match the results of the auctions to the physical constraints of the grid.[200] In effect, these markets are a complex mix of software and hardware that combine specific auction designs, subject to various market rules, with algorithms dedicated to optimizing power flow on the grid.[201] The overall goal is to ensure economic or least-cost dispatch of electric generating units subject to grid constraints (what is sometimes known as security constrained economic dispatch) based on the results of a sequence of day-ahead and real-time auctions.[202] The algorithms at the center of these markets

200. *See generally* Peter Cramton, *Electricity Market Design*, 33 OXFORD REV. ECON. POL'Y 589, 593–99 (2017) (describing the basic design of wholesale power markets); Udi Helman, Benjamin F. Hobbs & Richard P. O'Neill, *The Design of US Wholesale Energy and Ancillary Service Auction Markets: Theory and Practice*, *in* COMPETITIVE ELECTRICITY MARKETS: DESIGN, IMPLEMENTATION, PERFORMANCE 190–91 (Fereidoon P. Sioshansi ed., 2008) (discussing sequencing of electricity market auctions as constrained by the physical nature of the power system).

201. *See* Helman et al., *supra* note 200, at 197, 213–14 (discussing integration of day-ahead and real-time auctions in various optimization algorithms).

202. Dispatch is the process of coordinating and bringing on-line generation to meet customers' load requirements in real-time. *See* Paul L. Joskow, *Challenges for Wholesale Electricity Markets with Intermittent Renewable Generation at Scale: The US Experience*, 35 OXFORD REV. ECON. POL'Y 291, 300 (2019).

ultimately determine the resulting prices, influencing hundreds of millions of dollars in financial transactions every day.[203]

At the most basic level, the systems operation requirements in these markets are the same as those confronting traditional vertically integrated utilities. In both cases, systems operators will commit and dispatch generation units on the basis of cost subject to the physical requirements of the grid and the need to balance generation and load in real time. Thus, the process of committing power plants (scheduling them to be on and ready to generate power for certain hours of the next day), and the process for dispatching them (bringing them online to generate power in real time), are both based on least-cost principles (that is, lower cost units are committed and dispatched before higher cost units).[204] But all of this is ultimately subject to the physical constraints of the grid.[205] Both unit commitment and economic dispatch are thus "security constrained." The key point here is that the same principles apply to "security constrained unit commitment" and "security constrained economic dispatch" in both market and non-market (vertically integrated) systems.[206]

The main difference between the two models is that inputs into the unit commitment and dispatch algorithms in the markets are submitted by independent generators and load serving entities and are ultimately matched or cleared through a specific auction structure.[207] Systems operators in wholesale electricity markets, in other words, have much less control over generation (given that they do not own

203. *See* NAT'L ACADS. OF SCI., ENG'G, & MED., ANALYTIC RESEARCH FOUNDATIONS FOR THE NEXT-GENERATION ELECTRIC GRID 62 (2016) ("Because these algorithms sit at the center of wholesale electricity markets, they influence financial transactions of hundreds of millions of dollars daily.").

204. *See* ALEXANDRA VON MEIER, ELECTRIC POWER SYSTEMS: A CONCEPTUAL INTRODUCTION 260–67 (2006) (discussing electric power systems' operation tasks of scheduling and dispatch of generation).

205. Joskow, *supra* note 202, at 298.

206. *See, e.g.*, *id.* at 299 (noting that "the conceptual basis for the design of organized electricity markets in the U.S." can be traced directly back to optimal dispatch and optimal investment frameworks developed during the middle of the twentieth century for vertically integrated electric utilities).

207. *Id.* at 300 ("The initial design of organized wholesale markets in the US implicitly assumed that instead of 'central economic dispatch' by the vertically integrated system operator with a geographic monopoly based on the reported costs of each generator, competitive wholesale markets could be developed which replaced the vertically integrated central planner with competitive bidding by competing generators via appropriately designed auctions to define a least-cost dispatch curve (from lowest to highest marginal price bid to just meet demand at each point in time) for energy supply and ancillary network support services at each point in time (day-ahead and intraday hourly auctions).").

the generating facilities) and thus face a more complex set of challenges in coordinating and managing the system than their counterparts in vertically integrated utilities. They also typically manage systems that are much larger in scope than those managed by individual utilities.

In the early days of electricity, the systems control challenge was modest, with small, local power plants serving a limited number of end users.[208] During the 1920s and 1930s, as regional power networks expanded in scale and scope, the need for more formal control systems became apparent, and systems operators developed specialized slide rules, analog computers, and network analyzers to manage these networks.[209] Starting in the 1950s, early digital computers were used to analyze regional power networks.[210] And by the early 1960s, engineers formalized for the first time the problem of optimal power flow for regional electricity systems.[211]

Efforts to solve the optimal flow problem have proceeded apace, drawing upon increasingly powerful optimization tools made available by advances in linear and non-linear programming during the post-WWII period.[212] Since the 1960s, utility system operators have

208. *See* THOMAS P. HUGHES, NETWORKS OF POWER: ELECTRIFICATION IN WESTERN SOCIETY, 1880-1930, at 366 (1983) (discussing early direct-current and small local systems).

209. *See id.* at 372–75 (discussing early approaches to systems operation and control in U.S. regional power networks during the 1920s and 1930s); *see also* MARY B. CAIN, RICHARD P. O'NEIL & ANYA CASTILLO, HISTORY OF OPTIMAL POWER FLOW AND FORMULATIONS 7, 11–12 (2013), https://www.ferc.gov/sites/default/files/2020-05/acopf-1-history-formulation-testing.pdf [https://perma.cc/8H8Z-ZVPL] (discussing early efforts to "solve" the optimal power flow problem using engineering judgment, rules of thumb, specially-developed slide rules, and analog network analyzers).

210. *See, e.g.*, Rodney J. Brown & William F. Tinney, *Digital Solutions for Large Power Networks*, 76 TRANSACTIONS AM. INST. ELEC. ENG'G 347 (1957) (discussing early use of digital computers to solving power network problems).

211. *See* CAIN ET AL., *supra* note 209, at 7 ("The optimal power flow problem was first formulated in the 1960s, but has proven to be a very difficult problem to solve." (citation omitted)); *see also* J. Carpentier, *Optimal Power Flows*, 1 ELEC. POWER & ENERGY SYS. 3, 3 (1979) ("An optimal power flow may thus be defined as the determination of the complete state of a power system corresponding to the best operation within security constraints. Best operation usually means least fuel cost: security may range from the generation feasibility up to very sophisticated constraints, so that the optimization problem may become huge.").

212. *See* CAIN ET AL., *supra* note 209. Much of this work derived from the seminal contributions of George Dantzig to the field of linear programming starting in the late 1940s. In particular, Dantzig's development of the simplex algorithm at RAND in the late 1940s would prove to be enormously influential and important in solving optimization problems, including optimal power flow in electric power networks. *See* Robert E. Bixby, *A Brief History of Linear and Mixed-Integer Programming Computation*,

made use of various commercial algorithms and digital computers to manage their systems in accordance with the requirements of optimal power flow.[213] During this time, refinements of the algorithms, better software, and increases in computational capacity have translated into massive improvements in overall performance.[214] From the late 1980s to the early 2000s, for example, the speed of IBM's CPLEX algorithm (a commercial optimization algorithm used by several electricity markets) increased by some six orders of magnitude (a millionfold) as a result of the combined effects of algorithmic and machine improvements.[215]

This truly astonishing increase in performance over a period of less than twenty years provided much of the necessary technical foundation for the development of wholesale electricity markets during the 1990s and 2000s. Indeed, it is fair to say that these markets were not really feasible prior to this time—that is, they could not be developed until software and computational capacity had achieved a sufficient state of development. All of these markets, moreover, are still "software constrained," and small increases in the efficiency of these algorithms translate into billions of dollars in annual savings.[216]

Better algorithms and improved software for systems operation, however, were only a necessary first step in creating these markets. The markets themselves also had to be designed, which entailed all manner of choices regarding bidding, pricing, and settlement rules; the sequence of different markets for capacity, energy, and ancillary services; the locational effects of congestion; the value of physical

DOCUMENTA MATHEMATICA 107, 107 (2007); *see also* George B. Dantzig, *Origins of the Simplex Method*, *in* A HISTORY OF SCIENTIFIC COMPUTING 141 (Stephen Nash ed., 1990).

213. *See* M. Hunneault & F.D. Galiana, *A Survey of the Optimal Power Flow Literature*, 6 IEEE TRANSACTIONS ON POWER SYS. 762, 762 (1991); CAIN ET AL., *supra* note 209.

214. See CAIN ET AL., *supra* note 209, at 11–13.

215. Bixby, *supra* note 212, at 113–14 (reporting total improvement factor of 5,280,000 for IBM CPLEX linear programming code between 1988 and 2002). The CPLEX algorithm is itself based on the simplex algorithm developed by George Dantzig in the late 1940s. *Id.* at 107, 113.

216. *See* CAIN ET AL., *supra* note 209, at 4 ("Small increases in efficiency of dispatch are measured in billions of dollars per year."); *see also id.* ("The heart of economically efficient and reliable Independent System Operator (ISO) power markets is the alternating current optimal power flow (ACOPF) problem. The problem is complex economically, electrically and computationally. . . . Even 50 years after the problem was first formulated, we still lack a fast and robust solution technique for the full ACOPF. . . . While superior to their predecessors, today's approximation techniques may unnecessarily cost tens of billions of dollars per year. They may also result in environmental harm from unnecessary emissions and wasted energy."); Helman et al., *supra* note 200, at 236 (noting that "software has been a limiting factor in the development of efficient market designs").

attributes such as flexibility and so-called fast-ramping capacity; and, more recently, the integration of intermittent renewable resources and various demand-side and distributed resources. Needless to say, such an exercise represented far more than a simple withdrawal of regulation to allow markets to emerge.

Indeed, the task of designing and building these new electricity markets, like other market design efforts that were underway during the 1990s, reflected and drew upon the growing enthusiasm for mechanism design and experimental economics.[217] Economists working in these applied fields operated more as architects or engineers than as social scientists.[218] Along with the Federal Communications

217. *See* Philip Mirowski & Edward Nik-Khah, *Command Performance: Exploring What STS Thinks It Takes to Build a Market*, *in* LIVING IN A MATERIAL WORLD 90, 90–94 (Trevor Pinch & Richard Swedberg eds., 2008) (discussing rise of mechanism design within economics); *see also* sources cited *supra* note 56. Early conceptual work regarding the introduction of markets into various segments of the electric power industry is generally traced to PAUL L. JOSKOW & RICHARD SCHMALENSEE, MARKETS FOR POWER: AN ANALYSIS OF ELECTRIC UTILITY DEREGULATION (1983). In 1984, the Arizona Corporation Commission contracted with Vernon Smith's experimental economics group to investigate alternatives to cost-of-service regulation. Based on a series of laboratory experiments, Smith and his group produced a two-volume report for the Arizona Commission that failed to get traction. But Smith and his team used the experience to secure various consultancies with early pioneers in electricity deregulation such as New Zealand and Australia. Smith, together with leaders in mechanism design such as Robert Wilson, also played a critical role in articulating some of the basic design principles that informed U.S. efforts to restructure the power sector in the 1990s. *See, e.g.*, Vernon L. Smith, *Discovery Processes, Science, and 'Knowledge-How:' Competition as a Discovery Procedure in the Laboratory*, 28 REV. AUSTRIAN ECON. 237, 240 (2015) (discussing early work for the Arizona Corporation Commission, New Zealand, and Australia on electricity markets); Stephen J. Rassenti, Vernon L. Smith & Bart J. Wilson, *Using Experiments to Inform the Privatization/Deregulation Movement in Electricity*, 21 CATO J. 515, 517–38 (2002) (discussing involvement of the University of Arizona's experimental economics group in the design of various markets for electricity around the world); Robert Wilson, *Design Principles*, *in* DESIGNING COMPETITIVE ELECTRICITY MARKETS 159, 160–61 (Hung-po Chao & Hillard G. Huntington eds., 1998) (discussing different options for market architecture and procedural rules in designing electricity markets); *see also* Carine Staropoli & Celine Jullien, *Using Laboratory Experiments to Design Efficient Market Institutions: The Case of Wholesale Electricity Markets*, 77 ANNALS PUB. COOP. ECON. 555, 561 (2006) (discussing the use of experimental economics in designing markets for electricity). To be sure, there was also a great deal of market design work going on "down in the trenches" by regulators, consultants, and engineers who likely had very little idea about the central precepts of mechanism design.

218. *See* Roth, *supra* note 56; Eric S. Maskin, *Friedrich Von Hayek and Mechanism Design*, 28 REV. AUSTRIAN ECON. 247, 247 (2015) ("Mechanism design is the engineering part of economic theory. Usually, in economics, we take economic institutions as given and try to predict the economic or social outcomes that these institutions generate. But in mechanism design, we reverse the direction. We begin by identifying the outcomes that we *want*. Then we try to figure out whether some mechanism—some institution—

Commission auctions for radio spectrum, electricity markets provided an early test case for the new practitioners of mechanism design.[219] Unlike spectrum and other auctions, however, the task of designing new electricity markets was far more complicated.[220] Because of the relative freedom that the RTOs and ISOs have had to experiment with different designs (a result of FERC's open-architecture approach to RTO governance), moreover, these markets have all evolved somewhat differently and each has its own distinctive design.[221] But they do share several common features.

First, all of these markets use a uniform clearing-price design for their auctions.[222] Under this design, generators submit offers to sell specific quantities of electricity at specific prices.[223] These offers are then stacked from lowest to highest price.[224] On the buyer side, load serving entities (those who sell electricity to retail customers) likewise submit their bids to buy specific quantities of electricity at specific prices, which are then arranged from highest to lowest price.[225] The price at which supply and demand meet is the clearing price.[226] All generators with offers below that clearing price receive the clearing price regardless of the price of their submitted offers.[227] The

can be constructed to *deliver* those outcomes."); *see also* Robert Wilson, *Architecture of Power Markets*, 70 ECONOMETRICA 1299, 1299–1300 (2002) (discussing role of "economics as an engineering discipline capable of providing guidance on details of market design" in context of electricity markets and more generally).

219. *See, e.g.*, Francesco Guala, *Building Economic Machines: The FCC Auctions*, 32 STUD. HIST. & PHIL. SCI. 453, 456 (2001) (describing design of FCC auctions).

220. *See, e.g.*, Paul Milgrom, *Auction Market Design: Recent Innovations*, 11 ANN. REV. ECON. 383, 394 (2019) ("[E]nergy auctions are trickier than financial auctions because nonconvexities in power generation are important. There can be large fixed costs in turning on and ramping up a generator to supply power in the mid-afternoon and ramping it down when service is no longer needed. Standard price theory analyses do not dig deeply into these sorts of details, and auctions that are designed to operate independently in setting separate prices for different products may fail to coordinate producer activities well." (citation omitted)).

221. *See* Regional Transmission Organizations, *supra* note 66, at 811–12 ("We also establish an 'open architecture' policy regarding RTOs, whereby all RTO proposals must allow the RTO and its members the flexibility to improve their organizations in the future in terms of structure, operations, market support and geographic scope to meet market needs. In turn, the Commission will provide the regulatory flexibility to accommodate such improvement.").

222. *See* JEREMY LIN & FERNANDO H. MAGNAGO, ELECTRICITY MARKETS: THEORIES AND APPLICATIONS 224 (2017).

223. *Id.*

224. *Id.*

225. *Id.*

226. *Id.*

227. *Id.*

ranking of the generators that clear the market then determines the so-called merit order for commitment and dispatch.[228] Those generators that do not clear the market will not get committed or dispatched.[229] All load serving entities that submitted bids to buy at prices above the clearing price pay the clearing price regardless of the price of their submitted bid.[230] The basic theory behind this design is that it provides incentives for generators to offer their generation at their short-run marginal cost in order to ensure that they will clear the market and be dispatched.[231]

The goal of the uniform clearing-price auction, then, is to create a structure that will generate market outcomes as close to the neoclassical ideal of competitive markets as possible, where price equals marginal cost.[232] But, of course, as more than a few have pointed out, firms that only recover their short-run marginal costs will not stay in business for long—a point that is particularly germane for electricity generators who typically have high fixed costs.[233] The uniform clearing-

228. *Id.*

229. *Id.*

230. *Id.*

231. *See id. at* 224–25 (discussing general features of uniform clearing-price design); *see also id.* at 225 ("In such a pricing scheme, generators are more truthful in revealing their true marginal costs by bidding as close as possible or equal to their marginal costs."). The alternative design, known as "pay-as-bid" or discriminatory pricing, stacks submitted bids and offers in the same manner as the uniform clearing-price design, but generators that clear the market receive the price at which they offered to sell their power rather than the clearing price. *Id.* Likewise, load serving entities with bids that cleared the market will pay the price at which they bid rather than the clearing price. *Id.* As various observers have argued, this creates incentives for generators to "guess the clearing price" rather than submit offers at their marginal costs. *See id.* (observing that "pay-as-bid" pricing creates incentives for generators to "submit offers that reflected their best guess at what the cleared price will be for the most expensive needed resource, instead of bidding their actual costs as they do in a uniform price auction"). Although there was some debate in the United States about the merits of pay-as-bid after the California electricity crisis, all of the U.S. markets have continued to use the uniform clearing-price design. *See* ALFRED E. KAHN, PETER C. CRAMTON, ROBERT H. PORTER & RICHARD D. TABORS, PRICING IN THE CALIFORNIA POWER EXCHANGE ELECTRICITY MARKET: SHOULD CALIFORNIA SWITCH FROM UNIFORM PRICING TO PAY-AS-BID PRICING? 1–7 (2001) (concluding that a shift from uniform pricing to pay-as-bid pricing would be a mistake and would likely do more harm than good to consumers).

232. *See* Fed. Energy Regul. Comm'n v. Elec. Power Supply Ass'n, No. 14-840, slip op. at 5 (2016) (the clearing price is "the price an efficient market would produce").

233. *See, e.g.*, J.M. Clark, *Toward a Concept of Workable Competition*, 30 AM. ECON. REV. 241, 250 (1940) ("A price which at all times covers only short-run marginal cost would lead to large operating deficits whenever demand is short of capacity, and would bankrupt most industries, no matter how shock-proof their capital structures."); Joskow, *supra* note 206, at 303 (discussing the "revenue inadequacy" or

price auction design provides for this (at least in part) because lower cost generators are able to capture infra-marginal rents (the difference between the clearing price and their offer price), which can then be used to cover some of the generator's fixed costs. Whether these infra-marginal rents are sufficient to cover fixed costs and to encourage new market entrants is a question that all of the electricity markets are struggling with, as discussed in more detail below. Suffice it to say for now that all of this gets much harder in a world of cheap natural gas, which reduces the offer prices for natural gas generators that have typically been the marginal resource setting the clearing prices in the electricity auctions.[234] This is further compounded by the increasing supply of renewable generation, given that these resources have no short-run marginal costs (i.e., no fuel costs) and thus offer their power into the auctions at zero or even negative prices because of the subsidies they receive (tax credits, etc.).[235]

The second major design feature shared by the wholesale power markets is a sequence of day-ahead and real-time markets, both of which use the uniform-clearing price auction.[236] The day-ahead market is a market for the commitment or scheduling of generation units for every hour of the following day.[237] The outcome of the auction in this market, which is based on a "security constrained unit commitment" algorithm, is the schedule of supply resources (the stack of committed generation units that have cleared the market) needed to meet demand together with prices for each hour.[238] This outcome is financially but not physically binding on the participants.[239] The main

"missing money" problem that comes from over-reliance on short-run marginal cost pricing in the electricity markets).

234. *See* U.S. DEP'T OF ENERGY, STAFF REPORT TO THE SECRETARY ON ELECTRICITY MARKETS AND RELIABILITY 6 (2017) ("With the sustained drop in natural gas prices, . . . natural gas-fired combined-cycle (NGCC) plants are currently a less costly source of baseload generation than coal or nuclear power in many regions of the country.").

235. *Id.* at 10 (observing that high penetrations of variable renewable energy resources "with near-zero marginal costs . . . will lower wholesale energy prices independent of effects of the current low natural gas prices"); *see also* Dieter Helm & Cameron Hepburn, *The Age of Electricity*, 35 OXFORD REV. ECON. POL'Y 183, 189 (2019) ("A key feature of renewable electricity generating technologies is that they have close to zero marginal costs. . . . This represents a radical departure from the conventional cost structure of electricity markets.").

236. *See* Cramton, *supra* note 200, at 594.

237. *See id.*

238. *Id.*

239. *Id.*; *see also* LIN & MAGNAGO, *supra* note 222, at 182 ("The day-ahead market results—energy schedules and associated market prices—are contractually and financially binding to all market participants.").

purpose of the day-ahead market is to allow market participants to coordinate and plan for the next day and to hedge against more volatile real-time prices.

The real-time market, as the name suggests, is a series of auctions conducted throughout the operating day—at least every five minutes.[240] The outcome of these auctions, which is based on a "security constrained economic dispatch" algorithm, is the least-cost or economic dispatch of generation resources for every five-minute interval of the day.[241] The real-time market thus operates as a balancing market, in which economic dispatch is reconciled with actual system operating conditions (the physical constraints of the grid) and is used to adjust power sales and purchases to account for deviations from the amount of electricity traded in the day-ahead market.[242] Because the system must be balanced in every instant, however, generators and load serving entities literally have no time to find the "correct price." Instead, the market operator, using a combination of software and engineering judgment, enforces the power balance in real-time and then derives the prices for the appropriate intervals.[243] In effect, the market-clearing prices that result from the real-time auctions are a mathematical residual of the solution to the optimization problem of dispatching the appropriate amount of electricity in every instant to meet load.[244]

As one would expect, the volumes of electricity traded in the day-ahead market are much greater than those traded in the real-time markets, accounting for 85% or more of the total energy traded through these markets.[245] In essence, the day-ahead market allows for the bulk of the generation resources needed to meet demand during the next day to be scheduled and committed, while the real-time

240. *See id.*

241. *Id.*

242. The actual system operating conditions are provided by a state estimator that receives a continuous data feed from every node in the system. *See id.* at 187.

243. *Id.* ("Power balance is enforced at all times and real-time prices have to be discovered at fixed intervals of time. Load customers or generators have literally no time to find the right price, but to follow the determined prices that are determined by the market operator at fixed intervals.").

244. *Id.* at 212 ("The market-clearing process for an electricity market can be described as a process in which an optimization problem is solved.").

245. Across the different RTO/ISO markets trading in these two markets together accounts for between 45% and 70% of the total energy supplied during a given day, of which 85% or more is traded through the day-ahead market. *See id.* at 188. The remaining 30–55% comes from long-term bilateral contracts and self-scheduled resources (generation that is owned by load serving entities) that are scheduled into these markets as price-taking resources. *See id.*

market determines actual dispatch and balancing. The natural way of looking at these markets is as nested, complementary markets (what some refer to as a multi-settlement market) where the day-ahead market generates forward prices and the real-time market generates spot prices.

But the algorithms that run these markets are different, given that the physical system constraints incorporated into the market clearing algorithms vary depending on whether one is committing and scheduling generation units for the next day (the day-ahead market) or dispatching units in real time (the real-time market).[246] These differences create additional complexities in the markets and have been the subject of recent market manipulation cases regarding the use of so-called virtual bidding to arbitrage between the two markets.[247]

Virtual bidding (also known as "convergence bidding" in some markets) allows financial institutions and others to buy or sell "virtual" electricity in the day-ahead market and then close out those trades with the opposite transaction in the real-time market.[248] These are financial trades, and no physical electricity is ever delivered as a result of these transactions.[249] The theory behind virtual bidding is that the arbitrage opportunity it represents will improve liquidity in the markets and facilitate convergence between the prices in the day-ahead and real-time markets; that is, the additional trading will "arb

246. *See* John E. Parsons, Cathleen Colbert, Jeremy Larrieu, Taylor Martin & Erin Mastrangelo, *Financial Arbitrage and Efficient Dispatch in Wholesale Electricity Markets* 16 (MIT CEEPR, Working Paper No. 2015-002, 2015).

247. *See, e.g.*, *id.* ("Because the real problem is so much more complex than intersecting a pair of simple supply and demand curves, and because the Day-Ahead and Real-Time markets employ algorithms with different approximations, decompositions and judgments, a [Day-Ahead/Real-Time] spread can arise even when there is no simple deficiency of supply or demand bid into the Day-Ahead market. Since the problem is not caused by a simple deficiency of supply and demand, virtual bidding may not help to converge the prices. Worse still, virtual bidding may help converge the prices, but convergence may not correspond to improved system performance. In these cases, the profits on virtual bids can be a purely parasitic transfer from electricity customers.").

248. *See, e.g.*, Black Oak Energy, LLC v. Fed. Energy Regul. Comm'n, 725 F.3d 230, 239 (D.C. Cir. 2013) ("[U]nlike entities that traffic in electricity, the virtual marketers have a purely financial interest in the markets. They do not participate as producers or distributers of electricity, but rather as speculators and risk takers. . . . From FERC's policy perspective, the virtual marketers serve a useful purpose: they spot and exploit inefficiencies, driving prices closer to an accurate reflection of fundamental value." (citation omitted)).

249. *Id.* at 236 (noting that "the salient factor that distinguishes [virtual marketers] from all others who participate in the . . . market is that they never *actually* transmit or take delivery of electricity").

out" the price differences between the two markets.[250] But all of that assumes, of course, that these markets are nested—that they operate in actual fact as a multi-settlement market. In many cases, this may be a reasonable assumption, and there is empirical evidence that virtual bidding has facilitated convergence and improved efficiency.[251] In some cases, however, virtual bidding has been used to exploit differences in the rules, models, and algorithms underlying these markets resulting in several high-profile manipulation cases.[252] As a high-level RTO executive recently testified in Congress: "Trading this price inefficiency does not eliminate the inefficiency, it merely profits from it."[253]

The third common feature of the RTO/ISO markets in the United States is nodal pricing.[254] The objective here is to create a series of location-specific markets and prices across the network that will reflect congestion at specific locations (where congestion is understood as constraints on the capacity of the existing power lines).[255] Thus, for each identified node on the system, the market clearing algorithms will calculate a "locational marginal price" or LMP that is the clearing

250. *See* Black Oak Energy, L.L.C. v. PJM Interconnection, L.L.C., 125 FERC ¶ 61,042, at 15 (2008) (stating that the purpose of virtual bidding is to facilitate "transactions that reduce price divergence between the Day-Ahead and Real-Time markets").

251. *See, e.g.*, Akshaya Jha & Frank A. Wolak, *Can Financial Participants Improve Price Discovery and Efficiency in Multi-Settlement Markets with Trading Costs?* 14–18 (Nat'l Bureau of Econ. Rsch., Working Paper No. w25851, 2019), https://web.stanford.edu/group/fwolak/cgi-bin/sites/default/files/Jha_and_wolak_May_2019.pdf [https://perma.cc/8H8Z-ZVPL].

252. *See, e.g.*, Constellation Energy Commodities Grp., Inc., 138 FERC ¶ 61,168 (2012) (approving consent agreement regarding manipulation scheme in New York ISO market using virtual bidding to force price divergence in day-ahead and real-time markets in order to benefit various contracts-for-differences positions); ETRACOM LLC, 155 FERC ¶ 61,284, at 1 (2016) (assessing civil penalties for manipulation scheme in CAISO market using virtual bidding to increase congestion at certain locations and thereby increase the value of related congestions revenue rights contracts); *see also* Black Oak Energy, LLC v. Fed. Energy Regul. Comm'n, 725 F.3d 230, 239–40 (D.C. Cir. 2013) ("[T]heir unique position within the marketplace animates FERC's concern over whether virtual marketers will have a beneficial effect on the functioning of the markets. Since their business interests are purely speculative, . . . the virtual marketers pose a threat as potential market manipulators.").

253. *See Powering America: Examining the Role of Financial Trading in the Electricity Markets, Hearing Before the Subcomm. on Energy of the H. Comm. on Energy & Com.*, 115th Cong. 95 (2017) (statement of Vincent P. Duane, Senior V.P. Law, Compliance, and External Relations, PJM Interconnection, L.L.C.). As Duane stressed, "the important takeaway is to appreciate the rules, models, and algorithms that make up 'market design' bear significantly on how prices are formed." *Id*. at 94.

254. *See* LIN & MAGNAGO, *supra* note 222, at 214.

255. *See id.*

price for that node.[256] As the name suggests, LMP is calculated as the marginal cost of supplying an additional increment of load at a specific location taking account of network congestion.[257] For the day-ahead market, the market clearing algorithms use information on the expected state of the grid (the so-called network topologies) for each hour of the next day to compute hourly LMPs for each node on the system.[258] The LMP values that result are the prices that would be expected from competition in the presence of congestion as captured by the simulation of network topologies.[259] For the real-time markets, LMP is the price that would be expected to result from competition at a specific node, had there actually been a market at that location.[260]

Thus, the RTO/ISO market operators are really operating a series of different market simulations for each node on the system over different time intervals.[261] The prices that they generate for these different markets are products of the market-clearing algorithms that use the various offers and bids as inputs based on simulations and models of the expected and actual physical operation of the grid. In reality, these prices are artifacts of the software used to model and manage the grid and the markets themselves are best understood not as physical places where supply and demand meet but as computer programs that seek to mimic or simulate a market within the physical constraints of the grid.

256. *Id.*

257. LMP typically includes three components: the marginal price for energy, the marginal cost of congestion at the specific location, and the marginal loss of energy associated with transmission constraints at the specific location. *See id.* at 214–15.

258. *Id.* at 182–82.

259. *Id.*

260. *Id.* at 187–89.

261. *See infra* Figure 2.

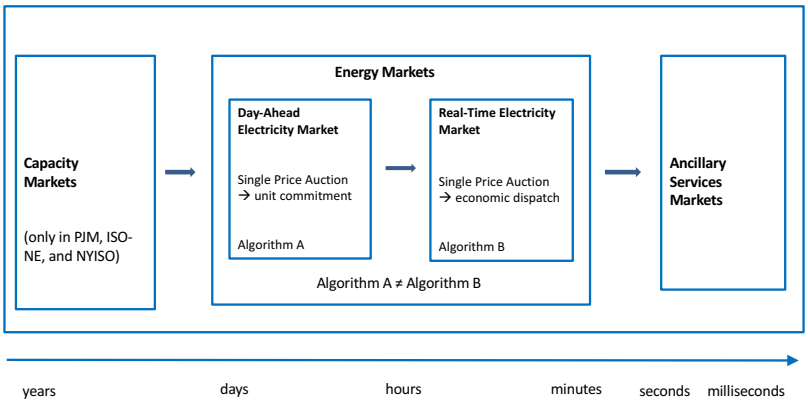

Figure 2: Price Making in Organized Wholesale Power Markets

This diagram illustrates the sequence of different markets and their respective time frames operated by the RTOs and ISOs.

Because each of the RTOs and ISOs have their own specific rules and market designs, they each use customized software packages to manage their markets. Currently, there are a handful of software vendors that provide the tools that run the organized wholesale power markets (Gurobi, GE/Alstom, and Siemens are the major players).[262] Most of them use some version of the core set of linear programming and mixed integer programming algorithms that have been developed over the last half century to solve complex optimization problems.[263] Notwithstanding their foundational importance to these markets and the prices that result, these vendors (and the tools they provide) are

262. Founded by Robert Bixby (a developer of the CPLEX optimization algorithm) and several colleagues, Gurobi provides the basic software that runs the ISO New York electricity markets. *See, e.g.*, ROBERT E. BIXBY, BUSINESS AND MATHEMATICS: A SAGA OF 25 YEARS OF PROGRESS IN OPTIMIZATION (2014), http://www.math.uwaterloo.ca/~hwolkowi/henry/teaching/f16/602.f16/602miscfiles/UF_Entrepreneurship_19November2014.pdf [https://perma.cc/EUR8-5PK2] (discussing Bixby's work with CPLEX and Gurobi's work with electricity markets); N.Y. INDEP. SYS. OPERATOR, 2018-2022 STRATEGIC PLAN 12, https://www.nyiso.com/documents/20142/2225883/2018+NYISO+Strategic+Plan.pdf [https://perma.cc/TQ4H-J4NN] (discussing Gurobi's work for New York ISO). GE acquired Alstom in 2015 and provides the basic software that runs the CAISO, ISO New England, MISO, and Southwest Power Pool electricity markets. *See* GEN. ELEC., DIGITAL ENERGY MARKET MANAGEMENT SYSTEM (2019), https://www.ge.com/digital/sites/default/files/download_assets/market-management-system-from-ge-digital.pdf [https://perma.cc/TE97-CWMB].

263. *See, e.g.*, YONGHONG CHEN, FENGYU WANG, JIE WAN & FENG PAN, DEVELOPING NEXT GENERATION ELECTRICITY MARKET CLEARING OPTIMIZATION SOFTWARE, 2018 IEEE POWER & ENERGY SOC'Y GEN. MEETING 1.

almost entirely insulated from ongoing discussions about oversight and regulation of the wholesale electricity markets. Like the price reporting agencies that publish the natural gas price indexes, they are largely invisible, even though their software determines how prices are made.

Viewed from the outside, the overall complexity of these markets is staggering, requiring highly specialized support structures and personnel to make them work. To take one example, in PJM, which is the largest wholesale power market in the United States serving more than 65 million people across various mid-Atlantic and midwestern states, market operators must contend on a daily basis with multiple offers from over 1,300 generators; 20,000 demand bids; 60,000 virtual bids and offers; 9,500 different pricing nodes; 20,000 different transmission elements; and some 6,000 different transmission contingencies that must be modeled.[264] Designing a mechanism that can manage the physical, economic, and computational complexity of these markets is a socio-technical achievement of the first order.[265] Designing an effective regime for oversight and regulation may well be beyond the capabilities of any institution.

In the face of such complexity, FERC has delegated much of the design and oversight of these markets to the RTOs and ISOs, which are themselves regulated by FERC as public utilities.[266] Aside from a series

264. *See PJM at a Glance*, PJM, https://www.pjm.com/~/media/about-pjm/newsroom/fact-sheets/pjm-at-a-glance.ashx [https://perma.cc/J8LS-QAHG]; MICHAEL J. WARD, PJM INTERCONNECTION, RESOURCE COMMITMENT AND DISPATCH IN THE PJM WHOLESALE ELECTRICITY MARKET 4 (2011) (summarizing average daily volumes in PJM markets); *see also* Cramton, *supra* note 236 ("The day-ahead and real-time optimization of resources involves state-of-art optimization techniques and hardware. To get a sense of the magnitude of the problem, ERCOT has thousands of computer servers to run its systems. This is very much a smart market. Preferences and constraints are expressed in sophisticated ways and then optimized to achieve the highest welfare possible.").

265. *See* Helman et al., *supra* note 200, at 181 ("These vast regional wholesale spot markets, several consisting of tens of thousands of simultaneously determined prices at locations on the grid, are one of the signal technological achievements to date of the regulatory reform of the U.S. electricity industry.").

266. *See* Order 888, *supra* note 15, at 21,540, 21,591–97 (encouraging formation of ISOs as vehicle for administering open access transmission and elaborating principles for ISO governance and operation); Regional Transmission Organizations, *supra* note 66, at 841–911 (identifying key characteristics and functions of RTOs); *see also* Michael H. Dworkin & Rachel Aslin Goldwasser, *Ensuring Consideration of the Public Interest in the Governance and Accountability of Regional Transmission Organizations*, 28 ENERGY L.J. 543, 554–57 (2007) (discussing various functions of RTOs); Hari M. Osofsky & Hannah J. Wiseman, *Hybrid Energy Governance*, 2014 U. ILL. L. REV. 1, 7 (describing RTOs as hybrid institutions); Shelley Welton, *Rethinking Grid Governance for the Climate Change Era*, 109 CALIF. L. REV (forthcoming 2021) (manuscript at 8–22) (on

of technical conferences on software needs in these markets and some remarks in various rulemakings about software constraints, moreover, the Commission has not directed any detailed regulatory attention to the algorithms and software used to run these markets.[267] Thus, most market design choices are made by the RTOs and ISOs through member-driven stakeholder processes.[268] These choices are then compiled in tariffs that are submitted to FERC, which sometimes leads to a back-and-forth between the Commission and the RTO/ISO. At its best, RTO/ISO governance looks like a successful venture in collaborative, multi-stakeholder governance that allows for and even promotes experimentation.[269] In practice, however, critics charge that it sometimes looks more like a private club dominated by industry incumbents and used to block competition from clean energy resources.[270] Although FERC's commitment to work with market participants through the RTO/ISO process and in various technical conferences recognizes these market actors not simply as targets of regulation but as design partners—an approach that has the potential to deliver meaningful engagement on highly technical questions, it is critical to recognize that market participants are often self-serving and cannot be counted upon to look out for the public interest. One major challenge for FERC, as discussed further below, is to ensure that the private interests that have such a strong voice in RTO/ISO governance do not marginalize the broader public interest in determining how prices are made in these different markets.

file with *Minnesota Law Review*) (discussing growth and development of RTOs and proliferation of different governance structures).

267. *See, e.g.*, Remedying Undue Discrimination Through Open Access Transmission Service and Standard Electricity Market Design, 67 Fed. Reg. 55,452, 55,498 (proposed Aug. 29, 2002) (to be codified at 18 C.F.R. pt. 35) (discussing market and operations software needs across the RTOs and ISOs); *see also* FED. ENERGY REGUL. COMM'N, RECENT ISO SOFTWARE ENHANCEMENTS AND FUTURE SOFTWARE AND MODELING PLANS (2011). FERC has also convened a series of annual technical conferences on software in the RTO and ISO markets. *See RTOs and ISOs*, FED. ENERGY REGUL. COMM'N (July 13, 2020), https://www.ferc.gov/industries/electric/indus-act/market-planning.asp [https://perma.cc/55W2-PK9K]. The most recent conference was in June 2019. *See* Notice of Technical Conference: Increasing Real-Time and Day-Ahead Market Efficiency and Enhancing Resilience Through Improved Software, 85 Fed. Reg. 11,068–69 (Feb. 26, 2020).

268. *See* Benjamin A. Stafford & Elizabeth J. Wilson, *Winds of Change in Energy Systems: Policy Implementation, Technology Deployment, and Regional Transmission Organizations*, 21 ENERGY RSCH. & SOC. SCI. 222, 230 (2016) (describing RTO stakeholder governance); Welton, *supra* note 266, at 17–20.

269. *See* Osofsky & Wiseman, *supra* note 266, at 7–11.

270. *See* Welton, *supra* note 266, at 13–14 (describing RTOs as "private, industry-led, voluntary clubs").

B. MARKET POWER, MARKET MANIPULATION, AND GAMING

FERC's overriding concern in its initial effort to restructure the electricity industry was to prevent the exercise of market power. Because of the physical constraints of the grid and the imperative of balancing supply and demand in real time, generators with market power could withhold some of their generation during times of scarcity (peak demand) or submit inflated offers in order to drive clearing prices higher.[271] FERC therefore focused on the structure of these markets and assumed that as long they were structurally competitive, the resulting prices could be deemed just and reasonable.[272]

The Commission's basic approach grew out of its experiments with market-based rates for bi-lateral sales of electricity in the late 1980s and early 1990s.[273] Drawing on antitrust conceptions of market power, the Commission developed *ex ante* screens to determine whether the seller possessed market power.[274] If the seller passed these screens, the Commission would grant it market-based rate authority—that is, the authority to go out into the market and sell power at market-based rates.[275] Various appellate decisions held that FERC's

271. *See, e.g.*, VON MEIER, *supra* note 204, at 295 ("The extreme inelasticity of demand and supply as the system nears its limits makes it vulnerable to the withholding of even small amounts of generation capacity."); Richard O'Neill & Udi Helman, *Regulatory Reform of the U.S. Wholesale Electricity Markets*, *in* CREATING COMPETITIVE MARKETS: THE POLITICS OF REGULATORY REFORM 141 (Marc K. Landy, Martin A. Levin & Martin Shapiro eds., 2007) ("There was not much question that in the transition from the era of monopoly regulation, the new electricity markets could be particularly prone to generation market power.").

272. *See* Helman et al., *supra* note 200, at 191–93 (discussing FERC's approach to market power in wholesale electricity markets).

273. *See* G. William Stafford, *Electric Wholesale Power Sales at Market-Based Rates*, 12 ENERGY L.J. 291, 291–94 (1991) (discussing FERC's early use of market-based rate authority).

274. Use of traditional concentration measures for determining market power in electricity has been criticized on various grounds given the distinctive nature of the electric grid and the possibility of more localized instances of market power that derive from network topologies. *See, e.g.*, Severin Borenstein, James Bushnell & Christopher R. Knittel, *Market Power in Electricity Markets: Beyond Concentration Measures*, 20 ENERGY J. 65, 86 (1999) (concluding that concentration measures "suffer from a number of weaknesses, which are exacerbated when applied to restructured electricity markets"); Staropoli & Jullien, *supra* note 217, at 564 ("Particularly for electricity, market power cannot be assessed based on traditional concentration measures alone. Notably, there is another type of market power, the local market power, which depends essentially on the localization on the network and the temporary topography of the network.").

275. *See* William H. Hieronymus, J. Stephen Henderson & Carolyn A. Berry, *Market Power Analysis of the Electricity Generation Sector*, 23 ENERGY L.J. 1, 36–41 (2002) (describing history of FERC's use of various market power screens for market-based rate

market-based rate program was consistent with the Federal Power Act, on the theory that competition would provide the discipline to ensure that rates (prices) would be just and reasonable.[276] Notably, the Supreme Court has never addressed the question of whether market-based rates are consistent with the Federal Power Act.[277]

While the system of market-based rates was designed for a world of bilateral contracts, it took on additional importance with the move to restructure wholesale markets in the late 1990s and early 2000s.[278] Merchant generators and electricity traders such as Enron were all required to secure market-based rate authority before they could participate in the new wholesale markets.[279] Needless to say, FERC's general assumption that this would ensure that markets were competitive proved to be mistaken.

In addition to these *ex ante* market screens, the RTOs and ISOs have also adopted market-mitigation procedures that are set forth in

authority). FERC's most significant recent effort to refine its approach to market-based rate authority came in 2015. *See* Refinements to Policies and Procedures for Market-Based Rates for Wholesale Sales of Electric Energy, Capacity and Ancillary Services by Public Utilities, Order 816, 153 FERC ¶ 61,337 (2015). FERC further refined its horizontal market power analysis in 2019. *See* Refinements to Horizontal Market Power Analysis for Sellers in Certain Regional Transmission Organization and Independent System Operator Markets, Order 861, 168 FERC ¶ 61,040 (2019) (to be codified at 18 C.F.R. pt. 35).

276. To date, the Ninth Circuit and the D.C. Circuit have held that market-based rates satisfy the just and reasonable standard. *See, e.g.*, California *ex rel.* Lockyer v. Fed. Energy Regul. Comm'n, 383 F.3d 1006, 1013 (9th Cir. 2004) ("[I]n a competitive market, where neither buyer nor seller has significant market power, it is rational to assume that the terms of their voluntary exchange are reasonable, and specifically to infer that the price is close to marginal cost, such that the seller makes only a normal return on its investment." (quoting Tejas Power Corp. v. Fed. Energy Regul. Comm'n, 908 F.2d 998, 1004 (D.C. Cir. 1990))).

277. *See* Morgan Stanley Cap. Grp., Inc. v. Pub. Util. Dist. No. 1 of Snohomish Cnty., 544 U.S. 527, 538 (2008) ("We have not hitherto approved, and express no opinion today, on the lawfulness of the market-based-tariff system, which is not one of the issues before us."); *see also* Spence & Prentice, *supra* note 163, at 197–200 (surveying the doctrinal landscape regarding the question of whether market based rates satisfy the just and reasonable standard).

278. *See* Market-Based Rates for Wholesale Sales of Electric Energy, Capacity, and Ancillary Services by Public Utilities, 72 Fed. Reg. 39,904, 39,904 (July 20, 2007) (codified as amended 18 C.F.R. pt. 35) (establishing system of market-based rates for wholesale sales of electricity).

279. *See Enron Power Marketing, Inc.*, 65 FERC ¶ 61,305 (1993); *Enron Energy Services Power, Inc.*, 81 FERC ¶ 61,267 (1997). In the wake of the California electricity crisis and evidence of Enron's efforts to manipulate the market, FERC revoked Enron's market-based rate authority in 2003. *See Order Revoking Market-Based Rate Authorities and Terminating Blanket Marketing Certificates*, 103 FERC ¶ 61,343 (2003).

their FERC approved tariffs.[280] Because prices set in the auctions cannot be mitigated after the fact, mitigation must proceed in real time. As market operators, the RTOs and ISOs are the only entities capable of performing these functions. Although the rules differ across the various RTOs and ISOs, each of them employs an independent market monitor that establishes reference prices for different generators that are then used to determine if the bids submitted by a generator are in line with their short-run marginal costs.[281] In cases where a submitted bid departs from the reference price by more than a specified threshold amount, the market operator will replace the submitted bid with the reference price.[282] For some generators, reference prices are determined on a daily basis.[283] In all of these markets, moreover, offers to sell electricity are also capped at an administratively determined value.[284] One would be forgiven for questioning whether this was all really just cost-of-service regulation by another name.[285]

During the early years of restructuring, FERC focused its oversight efforts almost exclusively on market structure. The goal was to

280. *See* Regional Transmission Organizations, *supra* note 66, at 896 (proposing that RTOs develop rules and procedures to identify and respond to problems of market power in real time).

281. FED. ENERGY REGUL. COMM'N, STAFF ANALYSIS OF ENERGY OFFER MITIGATION IN RTO AND ISO MARKETS, PRICE FORMATION IN ORGANIZED WHOLESALE ELECTRICITY MARKETS, DOCKET NO. AD14-14-000, at 4–7 (2014) [hereinafter STAFF ANALYSIS] (discussing procedures for setting reference level prices in RTO and ISO markets); *see also* Suedeen G. Kelly, Maria F. Vouras & Jennifer S. Amerkhail, *The Subdelegation Doctrine and the Application of Reference Prices in Mitigating Market Power*, 26 ENERGY L.J. 297, 303–16 (2005) (discussing different approaches of RTO/ISO market monitors in setting reference prices).

282. *See* STAFF ANALYSIS, *supra* note 281, at 6.

283. *Id.*

284. *See* 18 C.F.R. pt. 35 (2016) (establishing caps on energy offers at the higher of $1000/MWh or a resource's verified cost-based incremental offer and caps verified cost-based incremental offers at $2000/MWh). ERCOT has adopted much higher price caps.

285. This is perhaps most evident in the case of the capacity markets, which are structured around an administratively determined demand curve and include very specific rules that determine how various resources can participate. Daniel Breslau has described the PJM capacity market as a "market-like entity." *See* Daniel J. Breslau, *Designing a Market-Like Entity: Economics in the Politics of Market Formation*, 43 SOC. STUD. SCI. 829, 846 (2013); *see also* Calpine Corp. v. PJM Interconnection, L.L.C., 171 FERC ¶ 61,035, at 49 (2020) (Glick, Comm'r, dissenting) (observing that the order "creates a byzantine administrative pricing scheme that bears all the hallmarks of cost-of-service regulation, without any of the benefits"); *see also* Joshua C. Macey & Jackson Salovaara, *Rate Regulation Redux*, 169 U. PA. L. REV. 1181, 1236–47 (2020) (describing the ways in which capacity market rules and recent reforms have come to resemble traditional cost of service regulation).

ensure structurally competitive markets that would in turn produce just and reasonable prices.[286] The possibility of market manipulation and gaming, especially in the absence of market power, received very little attention. But the California crisis changed all of that, demonstrating that traders and other market participants could take advantage of market rules and manipulate the ways of price making irrespective of whether they had market power.[287]

The most famous (or infamous) of such market manipulation schemes were those employed by Enron traders.[288] Employing names such as Death Star, Fat Boy, Black Widow, Big Foot, and Get Shorty (among others), the Enron traders found multiple ways to game the California electricity markets.[289] Some of these strategies were based on the submission of false energy schedules and bids into the California Power Exchange (the spot market for wholesale electricity) that sought to take "unfair advantage" of the market rules and affect the resulting market prices.[290] Others were designed to "fool" the software managing the markets, particularly the congestion management program run by the California Independent System Operator or CAISO.[291] Although most of these strategies were viewed as inconsistent with the anti-gaming provisions of the CAISO and California Power Exchange tariffs, FERC had few tools at the time to address them.[292]

In addition to the Enron manipulation strategies, there was evidence of economic and physical withholding of generation from the California markets in order to drive the clearing prices in the auctions

286. *See, e.g.*, Remedying Undue Discrimination Through Open Access Transmission Service and Standard Electricity Market Design, 67 Fed. Reg. 55,452, 55,503 (proposed Aug. 29, 2002) ("The development of structurally competitive markets is the Commission's long-term goal.").

287. *See supra* note 67 (discussing the literature covering the California crisis).

288. *See* FINAL REPORT, *supra* note 17, chs. VI–VIII (discussing various Enron strategies).

289. *Id.*

290. *Id.*

291. *Id.*

292. *Id.* at ES-1 (concluding that "many trading strategies employed by Enron and other companies were undertaken in violation of antigaming provisions of the Commission-approved tariffs for the Cal ISO and Cal PX"); *see also Enron Power Marketing, Inc.*, 119 FERC ¶ 63,013, at 4 (2007) (concluding that Enron violated its market-based rate authority starting in 1997 by engaging in "gaming and anomalous market behavior by itself and in concert with others" and ordering disgorgement of more than $1.6 billion in unjust profits).

higher.[293] Although there was sufficient generating capacity "on paper" to supply the California market, ownership of relatively expensive gas-fired thermal units was concentrated in a handful of companies.[294] Because these resources typically set the clearing price during periods of peak demand, the owners had considerable incentives to engage in strategic bidding and withholding of generation in order to drive clearing prices higher.[295] These withholding strategies, in other words, were specifically intended to take advantage of the uniform clearing-price design in the markets.

As a mountain of post-crisis analysis has made clear, the California crisis resulted from a near perfect storm of bad design choices, software flaws, and a lack of attention to (and limited tools for dealing with) widespread manipulation and gaming—all taking place in the context of constrained generation capacity and challenging drought conditions across the western United States.[296] The overall costs to the California economy stemming from the disruption in both natural gas electricity markets were substantial—as much as $40 to $45 billion according to one estimate.[297]

In the wake of the crisis, FERC adopted new market behavior rules and Congress added new anti-manipulation provisions to the Federal Power Act, importing language from federal Securities laws and mirroring provisions added to the Natural Gas Act.[298] Congress

293. During the crisis, multiple factors conspired to drive wholesale prices in the California Power Exchange far above their pre-restructuring levels. On June 28, 2000, prices in the day-ahead market peaked at $1,099/MWh—a fifteen-fold increase over the pre-restructuring average cost of $74/MWh. *See* Order Proposing Remedies for California Wholesale Electric Markets, 93 FERC ¶ 61,121, at 12 (2000) (documenting price increases); Order Directing Remedies for California Wholesale Electric Markets, 93 FERC ¶ 61,294, at 19 (2000) (determining that pre-restructuring rates were around $74/MWh).

294. *See, e.g.*, STEVE ISSER, ELECTRICITY RESTRUCTURING IN THE UNITED STATES: MARKETS AND POLICY FROM THE 1978 ENERGY ACT TO THE PRESENT 250 (2015) (discussing evidence of strategic bidding and withholding by gas-fired thermal generation units during the early years of the California wholesale power market).

295. *See id.*

296. *See, e.g.*, WEARE, *supra* note 17. Two specific design flaws contributed substantially to the market dysfunction: (1) a prohibition on long-term contracts that forced the utilities into the spot market for virtually all of their power purchase needs, and (2) the lack of any demand response as a result of a decision to freeze retail rates. *Id.* at 93.

297. *Id.* at 3–4.

298. FERC's market behavior rules for electricity are codified at 18 C.F.R. § 35.41. FERC's regulations prohibiting electricity market manipulation are at 18 C.F.R. § 1c.2. EPAct 2005 added virtually identical anti-manipulation provisions to the Federal Power Act and the Natural Gas Act. *See* Energy Policy Act of 2005, Pub. L. No. 109-58,

also gave FERC expansive new civil penalty authority, which FERC has used vigorously over the last decade.[299] Taken together, these new tools provided an important complement to the Commission's ongoing efforts to prevent the exercise of market power. In effect, the use of *ex ante* market screens and the market power mitigation rules work to ensure that the markets are structurally competitive, while the conduct-based approaches provide a deterrent against market manipulation and gaming.

All of which has translated into a massive expansion of FERC's market analysis and surveillance operations as well as a substantial increase in the capacity of its enforcement division. On the market surveillance side, to take one example, FERC now receives, on a non-public basis, approximately seven gigabytes of data every day on market bids, offers, and, outcomes in the six RTO/ISO markets.[300] In 2018, the Commission's electricity market surveillance screens generated 369,230 alerts, more than a thousand a day on average.[301] Needless to say, keeping track of all of this is no small task and involves a very different skill set compared to what the Commission did prior to restructuring. Notwithstanding the fact that FERC's enabling statutes have changed very little since the 1930s, it is fair to say that the agency today is almost unrecognizable compared to its previous incarnation.[302]

And yet, even with the substantial resources it has devoted to analyzing market structure and policing market conduct, FERC continues to struggle with the actual mechanisms of price formation at the center of these markets. While the gaming and manipulation that were apparent in California resulted in part from structural problems in the markets and the lack of specific rules to prevent such behavior, these

§ 1283 119 Stat. 594, 979 (2005) (adding new anti-manipulation provisions to the Federal Power Act, codified at 16 U.S.C. § 824v).

299. EPAct 2005 gave FERC new civil penalty authority of up to $1 million per day per violation. *See* 16 U.S.C. § 825o-1. For a review of FERC's enforcement efforts after EPAct 2005, see STAFF WHITE PAPER, *supra* note 18.

300. *See* FED. ENERGY REGUL. COMM'N, 2019 REPORT ON ENFORCEMENT, DOCKET NO. AD07-13-013, at 72 (2019).

301. *Id.* at 74–75. These alerts led to twenty-three additional inquiries and five referrals for investigation. *Id.* at 8.

302. *See* Jody Freeman & David B. Spence, *Old Statutes, New Problems* 163 U. PA. L. REV. 1, 43–50 (2014) (discussing challenges that FERC has faced in trying to manage electricity restructuring and regulate electricity markets using tools and authorities from the Federal Power Act).

problems also stemmed from efforts to take advantage of the software and specific rules regarding participation in the electricity auctions.[303]

Since the California crisis, moreover, a significant number of FERC's electricity market manipulation cases have involved trading strategies that target market design flaws and software errors in the RTO and ISO markets.[304] FERC has taken the position that gaming of such flaws is manipulative conduct, and the Commission has initiated enforcement actions based on violations that it characterizes as exploiting known loopholes for "free money."[305] As these markets increase in complexity, such gaming will inevitably continue, forcing the Commission into a never ending dynamic of cat-and-mouse with sophisticated traders seeking ever more creative ways to profit from the specific rules and features of the ways of price making in these markets.[306]

To be sure, the problem of market manipulation is hardly unique to electricity, and FERC deserves enormous credit for substantially enhancing its ability to monitor market conduct and police against manipulation. But without also focusing directly on the ways of price

303. FERC's investigation of Enron's trading strategies found that Enron's cumulative profits from its electricity trades during the California crisis were around $1.8 billion. *See* FED. ENERGY REGUL. COMM'N, INITIAL REPORT ON COMPANY-SPECIFIC SEPARATE PROCEEDINGS AND GENERIC EVALUATIONS 83 (2002).

304. *See, e.g.*, *Make-Whole Payments and Related Bidding Strategies*, 144 FERC ¶ 61,068 at 13–14 (2013) (describing how JP Morgan Ventures Energy Corporation gamed the CAISO and MISO market software with a specific bidding strategy that triggered various above-market payments); *see also* STAFF WHITE PAPER, *supra* note 18, at 16–31 (reporting on various manipulation cases since 2005); Robert S. Fleishman & Paul C. Varnado, *Perspectives on FERC's Enforcement Program as It Relates to Energy Market Manipulation*, *in* THE GUIDE TO ENERGY MARKET MANIPULATION 15, 22 (Gordon Kaiser ed., 2018) ("A significant portion of FERC manipulation cases involve trading that occurred in the context of market design flaws and software errors in RTO and ISO electricity markets.").

305. *See* Houlian Chen, 151 FERC ¶ 61,179, at 2 (2015); JP Morgan Ventures Energy Corp., 144 FERC ¶ 61,068, at 17 (2013) (stating that "one of [FERC's] core responsibilities is detecting, preventing, and appropriately sanctioning the gaming of energy markets").

306. *See Make-Whole Payments and Related Bidding Strategies*, 144 FERC ¶ 61,068, at 15 (2013) ("In the wake of Enron's schemes in the CAISO market, the Energy Policy Act of 2005 gave the Commission 'broad authority to prohibit manipulation' and an 'intentionally broad proscription against all kinds of deception, manipulation, deceit and fraud.' Both the breadth of Congress's authorization to the Commission and the breadth of the Anti-Manipulation Rule itself are a response to what courts have long recognized: the impossibility of foreseeing the 'myriad means' of misconduct in which market participants may engage." (citing Cargill v. Hardin, 452 F.2d 1154, 1163 (8th Cir. 1971) ("The methods and techniques of manipulation are limited only by the ingenuity of man.")).

making in these markets, it is difficult for FERC to determine whether certain conduct should be considered legitimate or not. More importantly, as the markets themselves (and the pricing algorithms that power them) are further adjusted to accommodate the transition to a low-carbon electricity system, such challenges are sure to intensify. As we will see in the next section, moreover, these challenges are, at least in the first instance, less a matter of manipulation and gaming than they are about the more fundamental struggle over whether and how to value certain resources in the RTO/ISO pricing algorithms.

C. PRICE FORMATION AND FERC'S INSIDE/OUTSIDE PROBLEM

The theory behind the uniform clearing-price auction was that low-cost generators would capture infra-marginal rents (the difference between the clearing price and a generator's offer price) that they could use to cover their fixed costs.[307] In the early days of restructuring, there was a general view across the industry that natural gas would continue to be relatively expensive, with higher cost natural gas peaking plants always on the margin setting the clearing price during periods of peak demand. With the dramatic decline in natural gas prices since 2008 as a result of the shale gas boom, natural gas power plants' share of total electricity generation in the United States has increased significantly, largely at the expense of coal.[308] Over the same period, renewable energy, primarily wind and solar, has also grown considerably as a result of rapidly declining costs and government policy supports.[309] Taken together, these two developments—shale gas and cheap renewables—have led to substantial reductions in the clearing prices in the organized electricity markets.[310]

307. *See, e.g.*, PAUL L. JOSKOW, COMPETITIVE ELECTRICITY MARKETS AND INVESTMENT IN NEW GENERATING CAPACITY 9 (2006) ("Inframarginal generating units earn net revenues or quasi-rents that contribute to the recovery of their fixed operating and capital costs whenever the market clearing price exceeds their own marginal generation costs.").

308. *See* U.S. DEP'T OF ENERGY, *supra* note 234, at 13 ("The biggest contributor to coal and nuclear plant retirements has been the advantaged economics of natural gas-fired generation.").

309. *See* Lincoln L. Davies, *Eulogizing Renewable Energy Policy*, 33 J. LAND USE & ENV'T L. 309, 320–21 (2018) (discussing significant declines in costs of renewables and contribution of various policy supports); Helm & Hepburn, *supra* note 235, at 189 ("A key feature of renewable electricity generating technologies is that they have close to zero marginal costs. Unlike thermal electricity generation, which requires the purchase and combustion of coal, oil, or gas, the incoming energy from the sun and the wind is free, and the marginal costs are limited. This represents a radical departure from the conventional cost structure of electricity markets.").

310. Prices declined significantly in PJM from 2014 to 2018. *See generally* MONITORING ANALYTICS, L.L.C., 2018 STATE OF THE MARKET REPORT FOR PJM (2019).

Declining prices have in turn led to early retirements of baseload generation, mainly coal and nuclear power, but also (increasingly) more expensive natural gas units.[311] This has led to a proliferation of efforts inside and outside of the markets to create new revenues for particular types of generators. Over the last decade, multiple states have adopted various subsidy programs for certain types of resources.[312] Some of these subsidy programs have focused on encouraging investment in new generation within states while others have focused on providing additional revenues to existing generators at risk of early retirement.[313] In both cases, questions have emerged regarding how these state programs interact with FERC-regulated markets for capacity and energy.

Not surprisingly, litigation has ensued. In 2016, the Supreme Court struck down a Maryland program that required load serving entities in the state to sign long-term contracts for new natural gas generation that conditioned compensation on the ability of the generator to clear the PJM capacity market.[314] More recently, two appellate decisions upheld zero emission credit programs seeking to provide additional revenues to nuclear power plants in Illinois and New York[315] Although the Supreme Court recently denied cert in these cases, more litigation is brewing as other states such as Ohio and Indiana move forward with new subsidy programs.[316] We are back, it seems, to a

311. *See* U.S. DEP'T OF ENERGY, *supra* note 234.

312. *See, e.g.*, *Five States Have Implemented Programs to Assist Nuclear Power Plants*, ENERGY INFO. ADMIN. (Oct. 7, 2019), https://www.eia.gov/todayinenergy/detail.php?id=41534 [https://perma.cc/HEF4-PPPM] (discussing state programs in Connecticut, Illinois, New Jersey, New York, and Ohio to support nuclear power plants).

313. *Id.*; *see also* Hughes v. Talen Energy Mktg. LLC, 136 S. Ct. 1288 (2016) (addressing Maryland program to support new natural gas fired generation in the state).

314. The Court held that this requirement impermissibly interfered with FERC's jurisdiction over wholesale electricity markets because it explicitly tied compensation to the clearing prices in the PJM capacity market. *See Hughes*, 136 S. Ct. at 1292.

315. *See* Elec. Power Supply Ass'n v. Star, 904 F.3d 518, 523 (7th Cir. 2018) (upholding Illinois's zero emission credit (ZEC) program on grounds that it did not require recipients to participate in FERC regulated auctions); Coal. for Competitive Elec. v. Zilberman, 906 F.3d 41, 46 (2d Cir. 2018) (concluding that New York's ZEC program was not preempted under the FPA because there was no "impermissible tether" to the FERC regulated auctions as in Hughes).

316. *See, e.g.*, John Funk, *Ohio Gov DeWine Signs Controversial Nuke Subsidy Bill*, UTIL. DIVE (July 23, 2019) [hereinafter Funk, *Dewine*], https://www.utilitydive.com/news/breaking-ohio-passes-controversial-nuke-subsidy-bill-by-one-vote [https://perma.cc/7DCT-8D6Z]; Darren Sweeny, *Ind. Governor Signs Bill Pausing Coal Plant Retirements*, S&P GLOB. MKT. INTEL. (Mar. 24, 2020), https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/ind-governor-signs-bill-pausing-coal-plant-retirements-57738848 [https://perma.cc/8T8V-BEHF]. The

high-stakes version of what Walton Hamilton once called "price-by way of litigation."[317]

Meanwhile, there are vigorous ongoing debates within the RTOs and ISOs (and at FERC and the Department of Energy) over proposals to create new in-market products and rules to "enhance" price formation in a manner that monetizes certain attributes associated with certain types of resources.[318] The recent controversy over the Department of Energy's proposed rule on grid resiliency, which seeks to find additional ways to compensate baseload resources (i.e., coal and nuclear) for their contribution to grid reliability or resiliency is one example of this.[319] RTOs and ISOs have also created new market

Ohio legislation came under scrutiny in July 2020, when the state's Speaker of the House was charged in a $61 million bribery scheme associated with the legislation. John Funk, *Top Ohio Lawmaker Charged with Accepting $61M Bribe in Scheme To Pass Nuclear Bailout*, UTIL. DIVE (July 21, 2020), https://www.utilitydive.com/news/top-ohio-lawmaker-charged-with-accepting-61m-bribe-in-scheme-to-pass-nucle [https://perma.cc/L5FD-R5UM].

317. Hamilton was referring to the practice of utility ratemaking and its tendency to devolve into an elaborate process of adjudication. *See* Walton H. Hamilton, *Price—By Way of Litigation*, 38 COLUM. L. REV. 1008, 1034 (1938) ("The invocation of the courts is an extravagant expense to all concerned. It brings into the process of price-making the devices of litigation, contrived for another purpose, alien to the task, and set to a far slower tempo. The introduction of juristic procedures into the process of price-making is an invitation to frustration.").

318. *See* PJM INTERCONNECTION, PROPOSED ENHANCEMENTS TO ENERGY PRICE FORMATION 1–2 (2017) ("Today, the continuing penetration of zero marginal cost resources, declining natural gas prices, greater generator efficiency, and reduced generator margins resulting from low energy prices have resulted in a generation mix that is differentiated less by cost and more by physical operational attributes. As a result, enhancing energy price formation so the market sends better price signals has become more prominent and worthy of attention."). A critical view of the current situation in these markets might concur with Philip Mirowski and Edward Nik-Kah's observation that "[f]ixing markets with more markets is just another way that neoliberals have of never having to say they're sorry." *See* MIROWSKI & NIK-KHAH, *supra* note 37, at 236. A more earnest view sees these efforts as an ongoing set of pragmatic experiments aimed at shaping these markets during a time of enormous change. *Cf.* Fed. Power Comm'n v. La. Power & Light Co., 406 U.S. 621, 642 (1972) (observing that "agencies created to protect the public interest must be free, within the ambit of their statutory authority, to make the pragmatic adjustments which may be called for by particular circumstances").

319. *See* U.S. Dep't of Energy, Grid Resiliency Pricing Rule, Notice of Proposed Rulemaking, 82 Fed. Reg. 46,940, 46,942–44 (Oct. 10, 2017) (observing that "regulated wholesale markets are not adequately pricing resiliency attributes of fuel-secure generation" and directing FERC to consider new pricing rule that would require RTO and ISO markets to provide additional compensation to these generators). FERC terminated the proceeding shortly after the DOE issued its Notice of Proposed Rulemaking. But the Commission simultaneously initiated its own proceeding on the issue. *See Grid*

products that would provide additional compensation for so-called fast ramping capacity—that is, the capacity of certain generation (primarily natural gas plants) to quickly come on line in order to balance the intermittency associated with variable renewable resources.[320]

These recent in-market efforts are part of a broader, longstanding effort to modify the wholesale electricity markets to accommodate various types of resources—from new ancillary services to demand response, storage, and distributed generation. In examining these efforts, it is important to distinguish between those directed at relaxing or removing barriers to entry for new resources such as storage and demand response and those intended to correct or compensate for various "out-of-market" supports. As the electric generation mix continues to shift under the influence of cheap natural gas and higher penetration of renewables, there will inevitably be additional efforts to create new in-market products and rules to deal with various problems and "fix" the markets.[321]

What is important to recognize in the current moment is that these two problems are connected: as out-of-market payments further depress clearing prices, market participants push that much harder for additional compensation and favorable rules inside the markets. This inside/outside problem has consumed an enormous amount of attention in the RTOs and ISOs as well as at FERC, and some believe that it threatens the long-term viability of these markets.[322]

To take the most pertinent current example, some RTOs are now using minimum offer pricing rules as "in-market" tools in the capacity markets (the markets for future generating capacity) to mitigate the

Reliability and Resiliency Pricing, 162 FERC ¶ 61,012 (2018) (terminating DOE proceeding and initiating new proceeding).

320. *See, e.g.*, *California Independent System Operator Corporation*, 156 FERC ¶ 61,226 para. 36 (2016); *Midcontinent Independent System Operator, Inc.*, 149 FERC ¶ 61,095 (2014); *see also Fast-Start Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators*, 157 FERC ¶ 61,213 (2016).

321. PJM's recent proposal to "enhance" energy price formation is a good example, and points to the obvious challenge of deciding what should be the "correct" approach to pricing in these markets. *See* PJM INTERCONNECTION, *supra* note 318, at 5. ("Generally, low prices are desirable and beneficial for consumers—provided they continue to reflect the fundamentals of supply and demand in the market. However, to the extent that prices are suppressed by the analytical methods of the price calculation itself, an opportunity exists to enhance price formation by revising those methods.").

322. *See, e.g.*, RAYMOND L. GIFFORD & MATTHEW S. LARSON, 'AROUND MARKET,' 'IN MARKET,' AND FERC AT A CROSSROADS 20 (2018) (arguing that no "in-market" or "around market" solutions will be able to fix the problems in the RTO/ISO markets).

price suppression effects of state subsidies.[323] These rules were originally designed to control for buyer-side power—that is, the ability of load serving entities to suppress prices for future generation in the capacity market.[324] But as concerns over "out-of-market" payments to various generators have intensified, several RTOs have looked to the minimum offer pricing rule as a tool to provide a floor price for capacity that would mitigate the price suppression effects of these out-of-market payments.[325] By forcing all resources, including those receiving subsidies, to offer capacity at the minimum price, these rules seek to control for the situation where a generator receiving a subsidy would be willing to offer its capacity at a lower price because of the subsidy it receives.[326]

In contrast to its more typical posture of deference to RTO market design proposals, FERC has become quite involved in some of these efforts over the last several years. The Commission's recent actions with respect to PJM's proposed capacity market reforms reveal much about the current Commission's thinking on these issues. In June 2018, FERC took the unusual step of denying a market reform proposal developed by PJM based on several years of an intense multi-stakeholder process on the grounds that it did not go far enough in mitigating the "price suppressive" effects of out-of-market policy supports.[327] After an elaborate discussion regarding which subsidies were considered "material" and a deep dive into the details of PJM's two-stage auction design, the Commission, in a split 3-2 decision, rejected the proposal, concluding that it would "allow[] resources receiving out-of-market support to significantly affect capacity prices in a manner that will cause unjust and unreasonable and unduly

323. These issues are currently before the Commission in the context of efforts to reform the PJM capacity market to mitigate the "price-suppression" effects of state subsidies. *See, e.g.*, Calpine Corp. v. PJM Interconnection, LLC, 163 FERC ¶ 61,236 para. 1 (2018) ("[T]he integrity and effectiveness of the capacity market administered by PJM Interconnection, L.L.C. (PJM) have become untenably threatened by out-of-market payments provided or required by certain states for the purpose of supporting the entry or continued operation of preferred generation resources that may not otherwise be able to succeed in a competitive wholesale capacity market.").

324. *See* N.Y. State Pub. Serv. Comm'n v. N.Y. Indep. Sys. Operator, Inc., 158 FERC ¶ 61,137 para. 1 (2017) (Bay, Comm'r, concurring).

325. *Id.*

326. *See id.* at paras. 1–2 ("[T]he Commission's theory of the [minimum offer pricing rule] has changed, morphing from an examination of monopsony power to an examination of whether states have provided support or a subsidy to a resource that is selling into the capacity market.").

327. Calpine Corp. v. PJM Interconnection, LLC, 163 FERC ¶ 61,236 (2018).

discriminatory rates in PJM."[328] The majority continued, "[w]e cannot rely on such a construct to harness competitive market forces and produce just and reasonable rates."[329] In December 2019, FERC followed up with yet another Order on the matter, establishing its own revised capacity market design for PJM.[330] And in April 2020, the Commission denied various requests for rehearing and affirmed the basic elements of the December order, provoking yet another barrage of criticism and a vigorous dissent from Commissioner Richard Glick.[331]

The stated rationale for FERC's recent efforts to reform these markets is that they can somehow be made pure—isolated from the "distortionary" effects of background entitlements.[332] A moment's reflection, however, makes clear that these markets can never be made pure. Indeed, as former FERC Chairman Norman Bay observed in an earlier proceeding on minimum offer pricing rules:

> The pervasiveness of public policies that provide subsidies or impose costs on resources makes it futile to attempt to unwind them all. Assuming that it is even possible to determine a "subsidy-free offer," any attempt to unwind completely all subsidies and added costs necessarily assumes that some regulatory entity is capable of calculating the correct offer that resources must submit to the market. The clearing price from such a process could not

328. *Id.* at para. 156.

329. *Id.*

330. *See* Calpine Corp. v. PJM Interconnection, LLC, Order Establishing Just and Reasonable Rate, 169 FERC ¶ 61,239 (2019). This was the seventh time since 2006 that the Commission had intervened in the design of the PJM capacity market. In its December 2019 order, the Commission determined that any new or existing generation resource that receives a "State Subsidy" as defined by the Commission and that does not qualify for one of four exemptions would be subject to the MOPR. *See id.* at para. 9. The four exemptions include (1) existing "self-supply" or self-scheduled resources; (2) existing demand-response, energy efficiency, and storage resources; (3) existing renewable resources participating in state RPS programs; and (4) "new and existing resources that are not subsidized and thus do not generally require a review to protect 'the integrity and effectiveness of the capacity market'." *Id.* at para. 2.

331. *See* Calpine Corp. v. PJM Interconnection, LLC, Order on Rehearing and Clarification, 171 FERC ¶ 61,035 (2020); *see also id.* at para. 3 (Glick, Comm'r, dissenting) (referring to the Commission's December 2019 MOPR rule as turning "the 'market' into a system of bureaucratic pricing so pervasive that it would have made the Kremlin economists in the old Soviet Union blush").

332. *See* Calpine Corp. v. PJM Interconnection, LLC, 163 FERC ¶ 61,236 para. 2 (2018) ("With each such subsidy, the market becomes less grounded in fundamental principles of supply and demand."); *see also id.* at para. 150 (finding that PJM's proposed capacity market reform "fails to protect the integrity of competition in the wholesale capacity market against unreasonable price distortions and cost shifts caused by out-of-market support to keep existing uneconomic resources in operation, or to support the uneconomic entry of new resources, regardless of the generation type or quantity of the resources supported by such out-of-market support. The resulting price distortions compromise the capacity market's integrity.").

> credibly be called a market-based outcome. If a wholesale market operator tried to create an *ex ante* market free from the influence of public policy and the myriad of state and federal actions that impact supply and demand, this would create the most administrative construct of all. In short, the cure would be worse than the alleged disease.[333]

Simply put, there is no way to insulate these markets from the price "distorting" effects of public policy.[334] All generating resources are subsidized or penalized in one way or another and the proliferation of out-of-market payments and new in-market products and rule changes inevitably devolves into a line-drawing exercise that requires hard choices.[335] This is hardly a new problem. Nor is it one that is exclusive to electricity. In fact, it provides yet another illustration of the core legal realist insight that all market transactions (and all prices) are conditioned by background entitlements.[336]

Recognizing this, of course, does not provide an obvious solution to the challenges facing electricity markets. But it does help us see the incoherence of ongoing appeals to free markets and a level playing field in the current debates.[337] Whatever one thinks of his politics,

333. N.Y. State Pub. Serv. Comm'n v. N. Y. Indep. Sys. Operator, Inc., 158 FERC ¶ 61,137, at 6 (Bay, Comm'r, concurring); *see also id.* at 5 (noting that efforts to correct for state "intrusions" into the markets "assumes that a market can and should be free from out-of-market influences. . . . In point of fact, out-of-market influences are everywhere.").

334. *See* Calpine Corp. v. PJM Interconnection LLC, 163 FERC ¶ 61,236, at 8–9 (Glick, Comm'r, dissenting) ("If the Commission really wants to protect what it calls the 'integrity' of the capacity market, it would need to mitigate each and every federal, state, and local subsidy that allows a resource to lower its capacity market offer as well as the offers of vertically integrated utilities with guaranteed cost recovery. I suspect that we would soon find that there are few, if any, resources that would qualify to participate in PJM's capacity market without being subject to an offer floor.").

335. *See* Coal. for Competitive Elec. v. Zibelman, 906 F.3d 41, 57 (2d Cir. 2018) ("FERC uses auctions to set wholesale prices and to promote efficiency with the background assumption that the FPA establishes a dual regulatory system between the states and federal government and that the states engage in public policies that affect the wholesale markets."); Elec. Power Supply Ass'n v. Star, 904 F.3d 518, 524 (7th Cir. 2018) ("Instead of deeming state systems such as Illinois' [ZEC program] to be forbidden, the Commission has taken them as givens and set out to make the best of the situation they produce. . . . [T]he need to make adjustments [to the PJM capacity auction] in light of states' exercise of their lawful power does not diminish the scope of those powers.").

336. *See, e.g.*, Robert L. Hale, *Bargaining, Duress, and Economic Liberty*, 43 COLUM. L. REV. 603, 625–26 (1943) ("The market value of a property or a service is merely a measure of the strength of the bargaining power of the person who owns the one or renders the other, under the particular legal rights with which the law endows him, and the legal restrictions which it places on others.").

337. And these appeals are coming from all sides. *Compare* Rich Glick & Matthew Christiansen, *FERC and Climate Change*, 40 ENERGY L.J. 1, 6 (2019) ("[I]t is critical that all resources be able to compete on a level playing field in the wholesale electricity

former Secretary of Energy Rick Perry was surely correct when he stated that "there is no free market in the energy industry."[338] Indeed, once we acknowledge that there is no pre-political set of criteria for choosing among resources, it becomes impossible to avoid the push and pull of politics in deciding which resources, under which circumstances, will participate in the markets.

Seen in this light, it should not be a surprise that certain merchant generators and other market participants in the RTOs and ISOs are seeking to create new rules and products that will advantage them relative to other resources. While such activities might be viewed as detrimental to well-functioning markets, this simply begs the prior questions of whether, and on what terms, certain resources should be allowed to participate in the markets and who gets to decide.[339] Indeed, when one pulls back the curtain on price making within these markets, there is no lack of rent-seeking behavior to go around. Recent calls to reform RTO/ISO governance to increase participation and improve deliberation are surely worthy exercises, but this does not absolve FERC of its obligation to police these markets in a manner that protects the broader public interest.[340]

sector and that rules designed for conventional technologies are not barriers to entry of new ones."), *with* John S. Moot, *Subsidies, Climate Change, Electric Markets and the FERC*, 35 ENERGY L.J. 345, 346 (2014) ("Subsidies are creating a toxic mix of imperfect competition and imperfect regulation working directly at cross-purposes with each other.").

338. Timothy Cama, *Perry: 'There Is No Free Market in the Energy Industry*,' HILL (Oct. 6, 2017, 1:52 PM), https://thehill.com/policy/energy-environment/354270-perry-there-is-no-free-market-in-the-energy-industry [https://perma.cc/4NR2-7KHC]. *But see* Fed. Energy Regul. Comm'n v. Elec. Power Supply Ass'n, 136 S. Ct. 760, 768 (2016) ("In this new world [of competitive wholesale power markets], FERC . . . undertakes to ensure 'just and reasonable' wholesale rates by enhancing competition—attempting, as we recently explained, 'to break down regulatory and economic barriers that hinder a free market in wholesale electricity.'" (quoting *Morgan Stanley*, 554 U.S. at 536)).

339. *Cf.* Danny Cullenward & Shelley Welton, *The Quiet Undoing: How Regional Electricity Market Reforms Threaten State Clean Energy Goals*, YALE J. ON REGUL. BULL. (Nov. 8, 2018), https://www.yalejreg.com/bulletin/the-quiet-undoing-how-regional-electricity-market-reforms-threaten-state-clean-energy-goals [https://perma.cc/56W8-RSQD] (suggesting that there is a quiet effort underway seeking to undo "decades of progress" that FERC has made "in crafting robust, well-functioning regional energy markets").

340. *See, e.g.*, CHRISTINA SIMEONE, UNIV. OF PA. KLEINMAN CTR. FOR ENERGY POL'Y, PJM GOVERNANCE: CAN REFORMS IMPROVE OUTCOMES? 3–4 (2017) (outlining various proposed governance reforms for PJM and other RTOs); Dworkin & Goldwasser, *supra* note 266, at 593 (discussing FERC's responsibility to ensure that RTO governance advances the long-term public interest); Welton, *supra* note 266, at 58 (expressing "limited

Doing that effectively will require FERC to make some clear choices. For starters, the Commission should abandon its uneven and unsuccessful appeals to a vision of these markets as things that can somehow be kept pure.[341] Several former and current Commissioners have already embraced a version of this argument.[342] It is past time for the rest of the Commission to recognize the incoherence and confusion that results from efforts to promote an unrealistic view of these markets. Second, FERC should clarify once and for all that it will respect the structure of federalism in the Federal Power Act and allow state policy supports (of whatever kind) to flow through these markets without trying to develop offsetting in-market fixes. Here, the Commission will need to send a strong signal to the RTOs and ISOs, as well as to market participants, that it will be vigorous in policing their efforts to use rule changes and/or new in-market products to correct for out-of-market subsidies. Third, the Commission should continue working to find ways to allow new resources and technologies to access these markets, as it has already done with demand response, storage, and distributed generation.[343] In doing so, it will need to differentiate carefully between rules and products that promote entry and those that are directed at offsetting out-of-market supports by enhancing prices. This will not always be an easy line to draw, but FERC is in a better position to draw it than any other entity. Taken together, these three proposals offer a pragmatic approach to the organized

confidence that reforms focused on RTO's internal governance processes alone could adequately recalibrate sectoral responsibility").

341. The early vision of these markets promoted by some of the pioneers in mechanism design suggested that they could somehow be kept pure. *See, e.g.*, Vernon L. Smith, *Regulatory Reform in the Electric Power Industry*, 19 REGULATION 33, 44 (1996) ("[Central dispatch] is simply rule-governed, nerve-center coordination, based entirely on bids to buy power, and the offers to sell power or transmission services, by decentralized competing owners. Attempts to use the 'pool' or exchange to impose rules that are a disguised attempt to perpetuate regulation, or forms of political bias favoring particular interests, must be vigorously resisted. In electric power we are, and should be, talking about the development of a property-rights system—rights to inject or withdraw power, rights of transmission access, rights to invest and to claim the benefits (and incur the losses) that accrue to such investment.").

342. *See, e.g.*, Glick & Christiansen, *supra* note 337, at 14 (discussing the importance of ensuring current market rules do not become barriers to innovation); TONY CLARK, REGULATION AND MARKETS: IDEAS FOR SOLVING THE IDENTITY CRISIS 16 (2017).

343. *See, e.g.*, *Demand Response Compensation in Organized Wholesale Energy Markets*, Order No. 745, 134 FERC ¶ 61,187 (2011); *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators*, Order No. 841, 162 FERC ¶ 61,127 (2018); *Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators*, 172 FERC ¶ 61,247 (2020).

electricity markets, while still recognizing the delicate and contested ways of price making at their core as key pieces of infrastructure that require careful and ongoing regulation.

As noted, FERC has ample legal authority to regulate along these lines.[344] Even in a world where the Commission is relying upon competition and market forces to fix prices, it clearly has authority under its long-standing (and recently elaborated) jurisprudence regarding "practices" affecting rates to engage in any number of ways with the mechanics of price making in these markets.[345] Indeed, it would be difficult to think of a "practice" that more directly affects rates than the pricing algorithms, and the broader market rules that shape them, at the center of these markets. There are also good reasons why FERC should take a more proactive approach to regulating these pricing structures rather than delegating crucial questions of their design to the RTOs and ISOs. It is not obvious, in this respect, that the current version of multistakeholder governance operating in the RTOs and ISOs is the best way to design a market or that the outcomes of such processes are necessarily consistent with the public interest.[346]

The key takeaway here is that once we view these ways of price making as tools for harnessing the power of competition and directing it toward public ends, a more expansive set of choices opens up.[347] Thus, while decisions to value demand response, storage, distributed resources, resiliency, or flexibility in the markets (along with proposals to price carbon in various ways) will never get us any closer to the mythical level playing field, they can still rather easily be viewed as choices that fit within FERC's authority to regulate price formation in a manner that advances the public interest.

Some might argue in response that both FERC and the courts have already settled the question by embracing the view that ratemaking (and the just and reasonable standard that governs it) should never

344. *See supra* Part I.

345. *See* Fed. Energy Regul. Comm'n v. Elec. Power Supply Ass'n, 136 S. Ct. 760 (2016); Eisen, *supra* note 27.

346. *See, e.g.*, Shelley Welton, *Electricity Markets and the Social Project of Decarbonization*, 118 COLUM. L. REV. 1067, 1073 (2018) (characterizing RTO governance as "quasi-private, immensely technocratic, and largely opaque").

347. *Cf.* Jonas J. Monast, *Electricity Competition and the Public Good: Rethinking Markets and Monopolies*, 90 U. COLO. L. REV. 667, 706 (2019) ("Competition will continue to steer the evolution of the electricity sector in both restructured and traditionally regulated markets. The questions going forward are what form competition takes and what constraints public policy places on the scope of competition. Maximizing societal benefits in both restructured and traditionally regulated states depends on recognizing, and mitigating, instances when regulatory and market-design choices interfere with public goals." (footnotes omitted)).

try to accommodate extra-economic concerns, environmental or otherwise, that go beyond the traditional balancing of interests between ratepayers and investors.[348] As a doctrinal matter, such a view rests on a slender reed.[349] As a policy matter, it defies common sense given the unprecedented changes taking place in the electricity sector. Even for those on the fence about how to decarbonize the electricity sector, it does not take much of a leap to recognize that the public interest is expansive enough to encompass an approach to pricing that would encourage competition from new resources and products in order to facilitate a clean energy transition that is well underway.[350]

While climate policy is not the focus of this Article, it is indicative of the confusion that can result when we reify markets and assume that there is a correct way to design them. In the end, we need to recognize market design for what it is—a political exercise. Those in favor of aggressive climate action (including this author) should not be shy about arguing that electricity markets should not only accommodate state policies to support clean energy, but that they should be revised and redirected as needed to allow new resources and technologies to participate in order to facilitate the ongoing transition. Although a majority of the current FERC Commissioners seem to have limited interest in leading such an effort, there is nothing in the

348. *See, e.g.*, Grand Council of the Crees v. Fed. Energy Regul. Comm'n, 198 F.3d 950, 958 (D.C. Cir. 2000) (following *Hope Natural Gas* to conclude that ratemaking under § 205(a) of the Federal Power Act is "an effort to balance the interest of power consumers and producers" and that "[e]nvironmental interests appear orthogonal to both"); *see also* NAACP v. Fed. Power Comm'n, 425 U.S. 662, 669 (1976) ("This Court's cases have consistently held that the use of the words 'public interest' in a regulatory statute is not a broad license to promote the general public welfare. Rather, the words take meaning from the purposes of the regulatory legislation.").

349. *Grand Council of the Crees*, 198 F.3d at 957 (invoking *Chevron* deference to find that FERC's exclusion of environmental interests was a "reasonable" interpretation of the Federal Power Act in the face of congressional silence).

350. Several commentators and at least one FERC Commissioner have made versions of this argument. *See, e.g.*, Glick & Christiansen, *supra* note 337, at 45 ("The Commission's ultimate responsibility is to protect the 'public interest.' There is perhaps no greater concern to the public interest than the existential threat posed by anthropogenic climate change."); Christopher J. Bateman & James T.B. Tripp, *Toward Greener FERC Regulation of the Power Industry*, 38 HARV. ENV'T L. REV. 275 (2014) (arguing for a revised understanding of the public interest by FERC to accommodate a more proactive approach to climate change); *see also* Eisen, *supra* note 27 (arguing that FERC should ground carbon pricing in the RTO/ISO markets on its expansive authority to regulate "practices" affecting rates).

jurisprudence of the Federal Power Act that would necessarily preclude a future FERC from moving in this direction.[351]

In making such an argument, however, clean energy advocates should be careful to recognize that the shoe could end up on the other foot. While the structure of federalism that animates the Federal Power Act provides a solid legal justification for accommodating state policy supports in FERC regulated markets without trying to mitigate them with "fixes" inside those markets, there is no justification for deploying this sort of accommodation selectively to apply only to those policies that support one's preferred set of resources.[352] Likewise, for those promoting a more aggressive posture by FERC favoring carbon pricing in the RTO/ISO markets, such as the use of a carbon adder for all emitting resources,[353] those same arguments could be turned around to support a decision to impose a resiliency adder or some other market product that enhances the value of certain fossil fuel

351. There is always the question, of course, of how the federal courts and the current Supreme Court would react to such a move.

352. Some states, such as Ohio, have already adopted out-of-market payments for coal-fired generators, in addition to large nuclear plants. *See* Funk, *Dewine*, *supra* note 316. Others such as Indiana appear to be moving in this direction. *See, e.g.*, Catherine Morehouse, *Indiana Passes Coal Plant Support Bill as Democrats Removed from Conference Committee Deliberations*, UTIL. DIVE (Mar. 11, 2020), https://www.utilitydive.com/news/indiana-passes-coal-plant-support-bill-as-democrats-removed-from-conference [https://perma.cc/C4PV-HG9F].

353. *See, e.g.*, Eisen, *supra* note 27; Ari Peskoe, *Easing Jurisdictional Tensions by Integrating Public Policy in Wholesale Electricity Markets*, 38 ENERGY L.J. 1, 30–37 (2017) (discussing various legal arguments in favor of including a carbon adder in RTO/ISO markets); STEVEN WEISSMAN & ROMANY WEBB, U.C. BERKELEY CTR. FOR L., ENERGY, & ENV'T, ADDRESSING CLIMATE CHANGE WITHOUT LEGISLATION: HOW THE FEDERAL ENERGY REGULATORY COMMISSION CAN USE ITS EXISTING LEGAL AUTHORITY TO REDUCE GREENHOUSE GAS EMISSIONS AND INCREASE CLEAN ENERGY USE 10–11 (2014) (arguing that FERC does have legal authority to impose a carbon adder on wholesale sales of electricity). These proposals are often premised on the argument that carbon adders correct (at least in part) for the implicit subsidies that fossil fuel power plants enjoy as a result of the inability of current pricing structures to account for the environmental externalities associated with fossil fuel combustion. Although some market operators, such as CAISO, already have provisions in place to accommodate California's carbon pricing regime, the idea of using carbon pricing in the broader RTO/ISO markets appears to be gaining ground, especially as controversies over state policy supports intensify. In September 2020, FERC convened a technical conference to explore carbon pricing in the RTO/ISO markets. *See Technical Conference Regarding Carbon Pricing in Organized Wholesale Electricity Markets*, FERC (Sept. 30, 2020), https://www.ferc.gov/news-events/events/technical-conference-regarding-carbon-pricing-organized-wholesale-electricity [https://perma.cc/T8ZT-Y8BU]. And in October 2020, FERC issued a proposed policy statement on the issue. *See Carbon Pricing in Organized Wholesale Electricity Markets*, Proposed Policy Statement, Docket No. AD-20-14-000, 173 FERC ¶ 61,062 (Oct. 15, 2020).

generators. In the end, it is critical to recognize that the organized electricity markets will always be, at best, limited and imperfect vehicles for pursuing climate policy goals.

IV. WAYS OF PRICE MAKING AND THE CHALLENGE OF MARKET GOVERNANCE

In his dissenting opinion in the *Hope Natural Gas* case, Justice Jackson recognized the political nature of prices and the need to balance competing interests in any determination of rates.[354] "We should recognize 'price' for what it is," he wrote,

> a tool, a means, an expedient. In public hands, it has much the same economic effects as in private hands. . . . The fact is that in natural gas regulation price must be used to reconcile the private property right society has permitted to vest in an important natural resource with the claims of society upon it—price must draw a balance between wealth and welfare.[355]

For Jackson, striking the right balance was a task that required deep knowledge of the natural gas industry.[356] To that end, he warned against making "a fetish" of the formalisms of public utility accounting and the distortions that these created for the process of ratemaking.[357] Like Walton Hamilton and Louis Brandeis before him, Jackson knew that ratemaking could, and often did, devolve into a series of accounting rituals and bookkeeping exercises that obscured the deep play of economic interests.[358]

Hope, of course, is most famous because it finally put to rest the "fair value rule" of *Smyth v. Ames*, freeing ratemaking from the impossible task of determining the proper, constitutionally mandated value of utility assets.[359] Going forward, commissions were free to adopt

354. Fed. Power Comm'n v. Hope Nat. Gas Co., 320 U.S. 591, 653 (1944) (Jackson, J., dissenting).

355. *Id.*

356. *Id.* ("To carry this into techniques of inquiry is the task of the Commissioner rather than of the judge, and it certainly is no task to be solved by mere bookkeeping but requires the best economic talent available.").

357. Jackson appended a long footnote elaborating on this point: "To make a fetish of mere accounting is to shield from examination the deeper causes, forces, movements, and conditions which should govern rates." *Id*. at 643–44 n.40.

358. *Id.* (citing Walton Hamilton, *Cost as a Standard of Price*, 4 L. CONTEMP. PROBS. 321, 323–25); *see also* GERALD BERK, LOUIS BRANDEIS AND THE MAKING OF REGULATED COMPETITION, 1900-1932, at 23–25 (2009) (discussing Brandeis's view of the social construction of costs and the role of accounting).

359. *See* Smyth v. Ames, 169 U.S. 466, 546 (1898) (holding that "the basis of all calculations as to the reasonableness of the rates to be charged by a corporation maintaining a highway under legislative sanction must be the fair value of the property being used by it for the convenience of the public"). For a discussion of the controversy over the "fair value rule," see Boyd, *supra* note 6, at 761–69.

different methods of setting rates as long as the "end result" was just and reasonable.[360] Not surprisingly, the decision was widely (and rightly) hailed as a watershed not only in public utility regulation but also in the strong deference to regulatory agencies that marked the administrative law of the time.[361] For these reasons, *Hope* can make a strong claim to being the most important case in U.S. energy law.

But it is worth going back to *Hope* to consider the arguments made by the dissenting Justices and their implications for how we have thought about pricing and the public interest since the decision. Along with Jackson, Justice Frankfurter also dissented. In his view, the majority decision diminished the role of the courts in ensuring that regulation would proceed according to a broad understanding of the public interest.[362] "[T]he public interest," he wrote, "is a texture of multiple strands. It includes more than contemporary investors and contemporary consumers. The needs to be served are not restricted to immediacy, and social as well as economic costs must be counted."[363] Such a view had important implications for the Court's deference to the expertise of the Commission:

> It will not do to say that it must all be left to the skill of experts. Expertise is a rational process and a rational process implies expressed reasons for judgment. It will little advance the public interest to substitute for the hodge-podge of the rule in *Smyth v. Ames*, an encouragement of conscious obscurity or confusion in reaching a result, on the assumption that so long as the result appears harmless its basis is irrelevant.[364]

Implicit in Frankfurter's dissent was a concern with the details of price making. By focusing only on the "end result," the majority opinion worked to black box these details, thereby abandoning any

360. *Hope*, 320 U.S. at 602 ("Under the statutory standard of 'just and reasonable' it is the result reached not the method employed which is controlling. It is not theory but the impact of the rate order which counts. If the total effect of the rate order cannot be said to be unjust and unreasonable, judicial inquiry under the Act is at an end. The fact that the method employed to reach that result may contain infirmities is not then important." (citations omitted)).

361. *See* James C. Bonbright, *Utility Rate Control Reconsidered in the Light of the* Hope Natural Gas *Case*, 38 AM. ECON. REV. 465, 465 (1948) (describing the *Hope* decision as "one of the most important economic pronouncements in the history of American law"); *see also* Reuel E. Schiller, *The Era of Deference: Courts, Expertise, and the Emergence of New Deal Administrative Law*, 106 MICH. L. REV. 399, 441 (2007) (discussing *Hope* as an example of the "profound deference of New Deal-era administrative law").

362. *Hope*, 320 U.S. at 627 (Frankfurter, J., dissenting) ("But [the Natural Gas Act's] very foundation is the 'public interest,' and the public interest is a texture of multiple strands.").

363. *Id.*

364. *Id.* (citations omitted).

commitment to substantive review of the techniques of ratemaking.[365] This posture of deference, according to Frankfurter, ran counter to the foundational commitment to the public interest that animated the Natural Gas Act. The problem in the *Hope* case was thus not that the Federal Power Commission had fixed the rates too low, but rather "that the range of its vision was too narrow."[366]

Frankfurter was no stranger to public utility law. Along with many of his contemporaries, he wrote extensively about public utility regulation and its role in testing new approaches to the social control of business.[367] For him, the primary task of public utility regulation was to ensure that key systems of provisioning in a modern industrial economy—the "essential services" provided by public utilities—would always serve the broader public interest.[368] Although *Smyth v. Ames* had been a disaster, it was a mistake, Frankfurter seemed to be saying, to throw out the judiciary's duty to safeguard the broad public interest in its review of ratemaking by expert agencies. Simply put, one could dispense with the misguided effort to constitutionalize ratemaking that marked *Smyth v. Ames* while still holding on to an expansive view of the public interest.

There is some irony here. Frankfurter has been celebrated for his commitment to judicial deference to expert agencies during the New Deal era,[369] and *Hope* is often held out as the apotheosis of judicial deference to expertise in the field of ratemaking.[370] And yet, Frankfurter dissented in *Hope* and defended the role of the courts in protecting the

365. *Id.* at 603.

366. *Id.* at 627.

367. *See, e.g.*, FELIX FRANKFURTER, THE PUBLIC AND ITS GOVERNMENT 81 (1930); *see also* DANIEL ERNST, TOQUEVILLE'S NIGHTMARE: THE ADMINISTRATIVE STATE EMERGES IN AMERICA, 1900-1940, at 24 (2014) ("No economic issue was of greater concern to Frankfurter and other legal progressives in the 1920s than the regulation of public utilities." (footnote omitted)); William J. Novak, *Law and the Social Control of American Capitalism*, 60 EMORY L.J. 377, 399–404 (2010) (discussing importance of public utility to the broader Progressive agenda aimed at social control of business).

368. FRANKFURTER, *supra* note 367, at 81 ("No task more profoundly tests the capacity of our government, both in nation and state, than its share in securing for society those essential services which are furnished by public utilities. . . . The needs thus met are today as truly public services as the traditional government functions of police and justice.").

369. *See* Schiller, *supra* note 361, at 431 (noting that it was Frankfurter "who essentially stripped courts of their power to review ratemakings"); *see also id.* at 432 (quoting Frankfurter in *Railroad Commission of Texas v. Rowan & Nichols Oil Co.*, 310 U.S. 573, 584 (1940): "It is not for the federal courts to supplant the Commission's judgment even in the face of convincing proof that a different result would have been better.").

370. *Id.* at 440–41.

public interest from the more narrow, technocratic approach to ratemaking being developed by the Federal Power Commission.[371]

While Justices Frankfurter and Jackson obviously could not have foreseen the era of restructuring, the concerns they voiced in *Hope* are relevant to how we think about prices and the public interest in the current environment. By laying the groundwork for a narrow, economistic understanding of ratemaking and the prices that result, *Hope* worked to marginalize the broader notion of public interest that originally motivated public utility regulation and with it the notion that prices were tools to advance the public interest. This has carried through into the era of markets, reinforcing a certain invisibility that works to depoliticize the ways of price making at the center of these markets. Simply put, *Hope*'s command that we need not worry about the ways of price making as long as the result is just and reasonable has deflected attention from the question of how prices are actually made—a question that is no less relevant in the case of markets, than under cost-of-service ratemaking. As long as we stop short of asking that question and investigating the details of how these markets actually work, we will never be able understand the real politics at work in the economy.

A. KNOWLEDGE PROBLEMS

The price mechanism, Justice Douglas famously wrote in the *Socony-Vacuum* case, is the "central nervous system of the economy."[372] In that case, which involved an elaborate plan to control the supply of distressed gasoline so as to stabilize published price indices, the Court recognized that the "pricing structure" of a particular market could itself be the object of a price-fixing conspiracy.[373] The *Socony-Vacuum* case is known for its articulation of the rule that all price-fixing, no matter the origin or the effect, is *per se* illegal.[374] The rationale is simple and direct: distorted prices send bad signals which lead to coordination failures and inefficient allocation of resources. Only by protecting pricing structures from manipulation and collusion will the price system be able to perform its proper role.

371. *Hope*, 320 U.S. at 627.

372. United States v. Socony-Vacuum, 310 U.S. 150, 224 n.59 (1940).

373. *Id.* at 221 ("Any combination which tampers with price structures is engaged in unlawful activity. Even though the members of the price-fixing group were in no position to control the market, to the extent that they raised, lowered, or stabilized prices they would be directly interfering with the free play of market forces."); *see also* Daniel A. Crane, *The Story of* United States v. Socony-Vacuum: *Hot Oil and Antitrust in the Two New Deals*, *in* ANTITRUST STORIES (Daniel A. Crane & Eleanor Fox eds., 2007).

374. *Socony-Vacuum*, 310 U.S. at 221.

Consciously or not, Douglas's description echoed a Hayekian conception of the price system—one that viewed the price mechanism, when functioning in the context of competitive markets, as the best solution to the knowledge problem at the heart of modern economies.[375] For Hayek, the key to a well-functioning price system was robust competition, which he viewed as a means of discovery rather than an end-state.[376] Competition, Hayek argued, must be allowed to operate unfettered in order for the price system to work: "the price system will fulfill this function only if competition prevails, that is, if the individual producer has to adapt himself to price changes and cannot control them."[377] Government regulation, in turn, should operate solely in the background—defining property rights, promoting competition, and protecting the price system from the corrupting influences of politics and special interests.[378]

By emphasizing the superior epistemic performance of the price system and the limited knowledge of individual market participants, Hayek offered a powerful alternative to (and critique of) his life-long adversary, central planning, as well as the neoclassical model of

375. *See* Hayek, *The Use of Knowledge in Society*, *supra* note 3, at 526–27 ("We must look at the price system as such a mechanism for communicating information if we want to understand its real function. . . . The most significant fact about this system is the economy of knowledge with which it operates, or how little the individual participants need to know in order to be able to take the right action. . . . It is more than a metaphor to describe the price system as a kind of machinery for registering change, or a system of telecommunications which enables individual producers to watch merely the movement of a few pointers, as an engineer might watch the hands of a few dials, in order to adjust their activities to changes of which they may never know more than is reflected in the price movement."); *see also* Lynne Kiesling, *The Knowledge Problem*, *in* THE OXFORD HANDBOOK OF AUSTRIAN ECONOMICS (Christopher J. Coyne & Peter Boettke eds., 2015) (discussing Hayek's conception of the knowledge problem and the role of prices and market processes in providing a partial solution).

376. *See* Hayek, *Competition as a Discovery Procedure*, *supra* note 3.

377. FRIEDRICH A. HAYEK, THE ROAD TO SERFDOM 49 (1944).

378. *See* F.A. Hayek, *The Economy, Science and Politics*, *in* THE COLLECTED WORKS OF F. A. HAYEK VOL. 15: THE MARKET AND OTHER ORDERS 213, 225 (Bruce Caldwell ed., 2014) ("We know the general character of the self-regulating forces of the economy and the general conditions in which these forces will function or not function, but we do not know all the particular circumstances to which they bring about an adaptation. This is impossible because of the general interdependence of all parts of the economic process, that is because, in order to interfere successfully on any point, we would have to know all the details of the whole economy, not only of our own country but of the whole world. In so far as we want to avail ourselves of the forces of the market—and there can probably be no doubt that we must do so if we want even approximately to preserve our standard of life—it would seem that a rational economic policy should confine itself to creating the conditions in which the market will function as well as possible, but should not regard it as its task deliberately to influence or guide individual activities.").

perfect competition, with its assumptions of complete knowledge on the part of market actors.[379] And although Hayek clearly recognized that the price system did not always work as intended—that we are still "very far from having learned to make the best use of it"[380]—he implicitly rejected the idea that anyone could understand, much less intervene effectively in the process of price formation in different markets.[381]

And yet, Hayek's emphasis on the relative success of different institutional arrangements in working to solve the knowledge problem, together with his insights regarding the superior performance of competitive markets in aggregating knowledge and communicating that knowledge via prices, profoundly influenced subsequent developments in the economics of information and mechanism design that have in turn led to all manner of interventions in markets.[382] In

379. *See, e.g.*, Hayek, *The Use of Knowledge in Society*, *supra* note 3, at 527 ("But I fear that our theoretical habits of approaching the problem with the assumption of more or less perfect knowledge on the part of almost everyone has made us somewhat blind to the true function of the price mechanism and led us to apply rather misleading standards in judging its efficiency. The marvel is that in a case like that of a scarcity of one raw material, without an order being issued, without more than perhaps a handful of people knowing the cause, tens of thousands of people whose identity could not be ascertained by months of investigation, are made to use the material or its products more sparingly; *i.e.*, they move in the right direction.").

380. *Id.* at 528.

381. *See* Hayek, *supra* note 378, at 226 ("Not because he knows so much, but because he knows how much he would have to know in order to interfere successfully, and because he knows that he will never know all the relevant circumstances, it would seem that the economists should refrain from recommending isolated acts of interference even in conditions in which the theory tells him that they may sometimes be beneficial. The recognition of this limitation of our knowledge is important if we do not want to become responsible for measures which will do more harm than good.").

382. *See, e.g.*, Maskin, *supra* note 218, at 247 ("Friedrich von Hayek's work was an important precursor to the modern theory of mechanism design."); Robert Wilson, *John Harsanyi and the Economics of Information*, 14 GAMES & ECON. BEHAV. 296, 296 (1996) ("A half-century ago, Friedrich von Hayek (a 1974 Nobelist) offered a new perspective on markets, prices, and the invisible hand. In his view, the fundamental process of a market economy is price formation. He interprets prices resulting from competing bids and offers as summaries of information dispersed among traders. It is essential, but nonetheless amazing, that markets distill the welter of disparate information into terms of trade relevant for productive and allocative efficiency."). As discussed in Part III, *supra* notes 217–18, Wilson was deeply involved in electricity restructuring and the design of California's electricity market. Vernon Smith, another early proponent of the application of mechanism design and experimental economics to electricity restructuring, was also deeply influenced by Hayek. *See, e.g.*, Smith, *supra* note 217, at 242 ("[E]xperiments have long demonstrated Hayek's proposition [regarding competition as a discovery procedure]. People discover a price that they didn't know existed. They didn't know there would be some price that they would agree on, but they find it.").

particular, the idea that specific market arrangements could be constructed to harness the power of competition to generate prices that would solve coordination problems previously committed to regulation opened up a whole world of possibilities by providing a new set of tools to give effect to the broader goals of deregulation. At the heart of this work was a commitment to creating new rules and institutions—new "market architectures" to use Robert Wilson's phrase—that would establish a basis for competition and allow the Hayekian process of learning and discovery to proceed.[383]

In all of this, however, very little attention was given to the question of how politics and power relations influenced the process and substance of market design. The idea that newly constructed markets could be kept pure—encased in a set of rules and institutions that would keep politics at bay—was fundamental to the success of the effort. Actors were viewed as responding to, learning from, and acting strategically *within* the constraints of the particular arrangement (a specific auction structure for example), while almost no attention was given to the question of how those same actors might work strategically to shape the arrangement itself and thus to determine how competition would proceed. Put crudely, Hayek's epistemic conception of the price system, as activated in various applications of mechanism design, contains within it a deeply conservative posture of anti-politics that stops short of any serious investigation into the political economy of market design.

But once we recognize that price making cannot be understood in neutral, functionalist terms, efforts to design institutions to solve the knowledge problem become impossible to separate from politics. Viewed in this way, prices are not simply pieces of information, but are also objects of struggle—an insight that one can find in Max Weber's understanding of markets and prices as well as in the work of the institutional economists and legal realists, many of whom were writing at roughly the same time that Hayek was working out some of his early concepts of the price system.[384] By looking at the larger institutional and political environment in which decisions about market design are made, it becomes clear that there can never be any pre-political set of criteria for determining how to design markets and, in the process, how to shape and format competition.

383. *See* Wilson, *supra* note 217, at 160 ("The basic design choice is the architecture of the market."); *id.* at 161 ("The principle . . . is to treat the market design as establishing a mode of competition among the traders. The key is to select a mode of competition that is most effective in realizing the potential gains from trade.").

384. *See, e.g.*, WEBER, *supra* note 12, at 183; Hamilton, *supra* note 46, at 311.

Thus, to go back to the *Socony-Vacuum* case, the Court's focus on the manipulation of pricing structures in the oil industry, like the focus on manipulation of pricing structures in the contemporary natural gas and electricity markets, leaves unanswered the prior question of how the pricing structures themselves are constructed and whether they should be considered objects of investigation or regulation. Indeed, as the cases of natural gas and electricity make clear, the price mechanisms operating in particular markets are all to some degree contrived and, as a result, inevitably subject to politics. In each case, the specific ways of price making have provided partial solutions to the knowledge and coordination problems in these markets by opening up new spaces for the forces of competition to operate. But in both cases the specific ways of price making that emerged were the result of numerous design choices that, even though framed in the technical, seemingly neutral language of economics, have determined the nature and quality of competition and the distribution of opportunities among market participants. In both cases, moreover, the resulting prices—the index prices in natural gas and the clearing prices in the organized electricity markets—take on additional salience compared to other, more ordinary prices. Like other benchmark prices they are "systemically significant" in that they determine the value of other transactions and investments.[385] As a result, the ways of price making that determine these prices are the focus of great interest and ongoing struggle on the part of market participants.

B. THE HIDDEN ABODE OF PRICE MAKING

The critique of traditional public utility regulation (and much of the rationale for deregulation) depended fundamentally on the possibility that markets could be designed and overseen in a manner that would allow prices to form under competitive conditions. In the context of natural gas and electricity markets, FERC assumed that market forces and the discipline of competition would work to keep prices at their normal levels—that the market price was, in effect, the just and reasonable price. FERC learned the hard way that market forces cannot always be trusted to operate in a free and open manner. The California energy crisis demonstrated that it must be vigilant to protect against gaming and manipulation—that markets are fragile, that market design matters, and that the ways of price making at the heart of these markets can be objects of manipulation.[386]

385. *See* Hockett & Omarova, *supra* note 120.

386. *See supra* Parts II & III.

But the Commission has struggled to understand and surveil the ways of price making at the heart of these markets. While FERC has devoted significant attention to market structure and the conduct of market participants, it has so far not taken on the instrumentalities of price making themselves—leaving their regulation and oversight largely to third parties. This is a problem, not least because it calls into question the supposed advantage of transparency that has often been used to justify the replacement of regulation with markets.[387] As this Article has demonstrated, the ways of price making at the heart of both restructured natural gas and electricity markets are in many ways *less* transparent than the traditional cost-of-service approach they replaced. And while FERC has ample legal authority to engage in more direct oversight and regulation of these ways of price making should it choose to do so (and there are good reasons why it should), making these markets more transparent is easier said than done—a fact that is increasingly apparent as these markets (like others across the economy) become more sophisticated, more complex, and more automated.

The challenges that FERC faces in overseeing and regulating natural gas and electricity markets are thus similar in some ways to challenges facing other regulatory agencies in the so-called information age.[388] Understanding market-clearing algorithms and the ways in which they can be gamed is a very different (and much more difficult) task than ensuring a proper accounting has been made to determine cost-of-service and set rates. There are hard questions here about accountability that derive in part from deeper questions about epistemic competence. Can FERC really claim to understand how these markets function and can it in turn claim to be discharging its responsibilities if it continues to treat these indices and algorithms as black boxes? Should these ways of price making and, by extension, the governance of these markets be left largely to third parties?

Because the ways of price making at the heart of these markets are products of active design, they are inevitably subject to politics and contestation. In effect, the Weberian struggle over prices in the context of what he called the "market situation" has moved upstream

387. *See, e.g.*, MIROWSKI & NIK-KHAH, *supra* note 37, at 217–21 (noting the long history of arguments stressing the transparency of markets relative to regulation and showing how this is undermined in a world of market design where only the designers "truly understand [these markets'] setup and operation").

388. *See, e.g.*, Julie E. Cohen, *The Regulatory State in the Information Age*, 17 THEORETICAL INQUIRIES L. 369 (2016).

to become, primarily, a struggle over the ways of price making.[389] Once this is recognized, it is not hard to see how the often hidden and highly technical arena of price making is where the politics of markets are at their most intense—an observation that extends well beyond the cases discussed in this Article to the large and growing number of boutique markets and platforms that are based on new, often algorithmic, approaches to price making.[390]

Such a view has important normative implications. If we approach the indices and algorithms at the heart of restructured natural gas and electricity markets as part of the common infrastructure supporting these markets, it is relatively easy to conclude that there is a strong public interest in ensuring that they have integrity and are able to perform their services as intended.[391] More generally, once we recognize that market devices and the various ways of price making in different markets are objects of conscious design and struggle, it is relatively easy to see how questions of market power and anti-competitive conduct are intimately connected with the microstructures of price formation.[392] By determining the manner in which competition

389. WEBER, *supra* note 12, at 168–72.

390. *See* MATTLI, *supra* note 13; *see also* Samuel Bowles, Alan Kirman & Rajiv Sethi, *Friedrich Hayek and the Market Algorithm*, 31 J. ECON. PERSP. 215, 217 (2017) ("Many markets now involve algorithmic price-setting and order placement alongside direct human action, raising interesting new questions about the processes by which information is absorbed and transmitted by prices.").

391. There is some precedent for this in the line of cases following *Munn v. Illinois*, 94 U.S. 113 (1876). *See, e.g.*, Kinsey Co. v. Bd. of Trade, 198 U.S. 236, 249 (1905) ("[T]he quotations of prices from the market are of the utmost importance to the business world, and not least to the farmers; so important, indeed, that it is argued here and has been held in Illinois that the quotations are clothed with a public use."). The case was on appeal from an Illinois Supreme Court case, *New York & Chicago Grain & Stock Exchange v. Board of Trade of Chicago*, 127 Ill. 153 (1889), which characterized the market statistics and the rules and regulations of the Board of Trade in disseminating those statistics as clothed with a public interest as understood in *Munn* and thus subject to regulation. *See also* German All. Ins. Co. v. Lewis, 233 U.S. 389, 416–17 (1914) ("We may venture to observe that the price of insurance is not fixed over the counters of the companies by what Adam Smith calls the higgling of the market, but formed in the councils of the underwriters, promulgated in schedules of practically controlling constancy which the applicant for insurance is powerless to oppose and which, therefore, has led to the assertion that the business of insurance is of monopolistic character and that 'it is illusory to speak of a liberty of contract.'").

392. I am indebted to Josh Macey for helping me see this point. Carl Pechman made a somewhat analogous point in his 1993 book on the electricity industry, in which he argues that the ability of firms to specify and manipulate access to the computer models used for electric power systems operation and control provided a source of market power that was inhibiting the transition to a more competitive generation market. *See* CARL PECHMAN, REGULATING POWER: THE ECONOMICS OF ELECTRICITY IN THE INFORMATION AGE 3 (1993).

will proceed, the different ways of price making operating at the heart of various markets and platforms across the economy—from natural gas and electricity to Uber and Amazon—are, to use the old words, "clothed with a public interest."[393] To be sure, all of this begs the question of what integrity means and who gets to determine the public interest—questions that cannot be answered without getting into matters of politics and institutional competence. But these are the questions that have animated economic regulation since its inception, and it is a mistake to view the move to markets as somehow dispensing with them.

C. PUBLIC UTILITY AND MARKET GOVERNANCE

Public utility law has always lived in the shadow of the market. The standard view of rate regulation sees it as a way of carving off or ring-fencing certain sectors of the economy from the typical approach of using the antitrust laws to protect competition. Implicit in this view is the idea that competitive markets are a more natural way to organize economic activity, and that regulation should be used only when absolutely necessary.[394]

This view has been widely endorsed by judges, lawyers, and scholars from across the political spectrum, reflecting a quintessential American commitment to free enterprise and the power of markets.[395] But one can still embrace the wisdom implicit in such a view while also recognizing that markets can be quite fragile and difficult to manage. Like regulation, markets are means not ends. As such, they need to be

393. *See* Munn v. Illinois, 94 U.S. 113, 126 (1877) ("Property does become clothed with a public interest when used in a manner to make it of public consequence, and affect the community at large.").

394. *Cf.* Stephen G. Breyer, *Antitrust, Deregulation, and the Newly Liberated Marketplace*, 75 CALIF. L. REV. 1005, 1007 (1987) ("Regulation is viewed as a substitute for competition, to be used only as a weapon of last resort—as a heroic cure reserved for a serious disease."); JAMES C. BONBRIGHT, ALBERT L. DANIELSEN & DAVID R. KAMERSCHEN, PRINCIPLES OF PUBLIC UTILITY RATES 141 (2d ed. 1988) ("Regulation, it is said, is a substitute for competition. Hence its objective should be to compel a regulated enterprise, despite its possession of complete or partial monopoly, to charge rates approximating those which it would charge if free from regulation, but subject to the market forces of competition.").

395. *See, e.g.*, Standard Oil Co. v. FTC, 340 U.S. 231, 248 (1951) ("The heart of our national economic policy long has been faith in the value of competition."); Thomas K. McCraw, *What Economists Have Thought About Competition and What Difference It Makes*, 101 PROC. MASS. HIST. SOC'Y 24 (1989) (reviewing American thinking on market competition).

actively managed, adjusted, and redirected on occasion.[396] From this perspective, markets are fragile not because they are vulnerable to politics, but because we have failed to recognize that they are inherently political.[397]

To say this is not simply to recognize (again) that our standard conception of markets is incomplete and overly abstract. Nor is it just another way of repackaging the legal realist insight that all markets are in fact legal entities—that there is no such thing as a "free market."[398] Recent work traveling under the label of law and political economy, the resurgence of interest in Brandeis, and growing concerns about economic concentration in the platform economy have all brought the question of markets back into a broader conversation among legal scholars.[399] All of this is a welcome and important development, but we make a mistake if we allow that conversation to operate at the same level of abstraction and generality that has framed the debate about regulation and markets for much of the last half century. When we talk about "the market" or "the price system," as we all do, we need to be careful to recognize how much discursive work these concepts do and how they often obscure the actual concrete practices, techniques, and devices that constitute markets.[400]

396. *See* MACKENZIE, *supra* note 9, at 275 ("Markets, like technologies, are surely means—to be tinkered with, modified, redesigned, improved, and on occasion delimited—not ends that can only be embraced or rejected.").

397. Breslau, *supra* note 285, at 830 ("Markets are products of a political process. Of the elements that comprise markets—property rights, rules of exchange, unwritten norms, and a cultural context—all are potential objects of political contention, and their configuration at any moment is the product of previous rounds of struggle.").

398. *Cf.* HARCOURT, *supra* note 41, at 242 ("At the end of the day, the notion of a 'free market' is a fiction. There simply is no such thing as a nonregulated market—a market that operates without legal, social, and professional regulation. . . . The question is thus not *whether* to regulate. Instead the only question is *how* the existing and prospective kinds of regulation distribute wealth. That is the only important question and it is, tragically, masked by our faith in natural order and efficient markets.").

399. *See, e.g.*, Jedediah Britton-Purdy, David Singh Grewal, Amy Kapczynski & K. Sabeel Rahman, *Building a Law-and-Political-Economy Framework: Beyond the Twentieth-Century Synthesis*, 129 YALE L.J. 1784 (2020) (arguing for a new "law-and-political-economy" approach to legal scholarship built upon a reorientation from twentieth century concerns with efficiency, neutrality, and anti-politics toward power, equality, and democracy); Lina Khan, *The Separation of Platforms and Commerce*, 119 COLUM. L. REV. 973, 976–79 (2019) (discussing ways in which dominant online platforms stifle competition and distort markets); TIM WU, THE CURSE OF BIGNESS: ANTITRUST IN THE NEW GILDED AGE (2018) (arguing for a recovery of the concerns of Brandeis and other Progressives with economic concentration and the need for a revitalized approach to antitrust).

400. *See* DANIEL T. RODGERS, AGE OF FRACTURE 47 (2011) ("By the end of the 1970s, a new idea of the market, cut free from the institutional and sociological relationships

This Article has embraced the notion that we need to investigate these techniques and practices directly. In doing so, we need to recognize that market actors and market participants are intimately bound up with these techniques. And we need to acknowledge that regulation ignores these techniques (or assumes them away) at its peril. Put another way, the varied and variable ways of price making within particular markets need to be taken seriously as objects of investigation. We need more concrete histories of how actual markets work to complement our already well-developed intellectual histories of how they should work in the abstract.[401]

By focusing on the actual mechanics and relative merits of different techniques of price making, we can perhaps start to move past the stale and unproductive opposition of regulation and markets that has structured so much of energy law and the broader field of economic regulation for the last fifty years and that has left policymakers, judges, and scholars (among others) struggling to find a vocabulary with which to engage these questions. Viewed from this perspective, it may be more productive to think of public utility less as an antiquated form of governmental price fixing that operates as a substitute for markets than as a political rationality of price making for key systems of provisioning—one that is manifest in an ongoing set of experiments with different institutional forms and practices (including markets), all of which are (or should be) grounded in a commitment to fair prices and a broad conception of the public interest. Taking such a view, this Article contends, brings into relief an older set of questions about politics and markets, reminding us that markets and the price mechanisms that power them have always been political instruments, even and especially when they are represented as natural or efficient solutions to the problem of economic coordination.

CONCLUSION

"Preoccupation with the ethics of pricing," Joseph Schumpeter observed, "is precisely one of the strongest motives a man can

constitutive of earlier economic analysis . . . was being called on to do unprecedented amounts of thinking.").

401. *Cf.* Callon & Muniesa, *supra* note 62, at 1240 (observing that abstract conceptions of "the market" have made concrete markets invisible and seldom studied); Philip Mirowski, *Markets Come to Bits: Evolution, Computation, and Markomata in Economic Science*, 63 J. ECON. BEHAV. & ORG. 209, 220 (2007) (criticizing the "habit of regarding all markets as minor variations on homogeneous auctions, rather than keeping in view the variegated motley of species that is revealed in a proper natural history of markets").

possibly have for analyzing actual market mechanisms."[402] Although Schumpeter was discussing the economic theories of the Scholastics, his observation holds for our own time, reminding us that a concern with the normative dimensions of prices leads one almost inevitably into an investigation of *how* prices are formed or made in particular circumstances.

This Article has taken this commitment to heart in a wide-ranging investigation of the ways of price making in restructured natural gas and electricity markets. In doing so, it has drawn upon a diverse array of sources (old and new) to develop a novel perspective on these markets, training attention to the techniques and practices that generate prices and determine the ways in which competition proceeds.

Such a perspective, it is argued, leads to a more realistic understanding of what these markets can and cannot do as well as a more robust set of considerations for reform. But it is also generative beyond the specific cases addressed here and increasingly relevant in the face of growing enthusiasm for designer markets and the adoption of new, often algorithmic, approaches to pricing across the economy. In all of these cases, careful attention to the techniques and practices of price making helps to surface important questions about politics, fairness, and the public interest that have lain dormant for too long.

402. JOSEPH A. SCHUMPETER, HISTORY OF ECONOMIC ANALYSIS 60 (1954).